NATURE STUDY IN THE SCHOOL

ESCUELA TECNICA SUPERIOR DE INGENIEROS AGRONOMOS - BIBLIOTECA - SONOTECA

By VILHELM RASMUSSEN

THE KINDERGARTEN CHILD: Its Conception of Life and its Mental Powers

THE KINDERGARTEN CHILD: Thought, Imagination and Feeling, Will and Morale

THE PRIMARY SCHOOL CHILD

THE INTERMEDIATE SCHOOL CHILD

Naturaleza en la escuela

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BY

VILHELM RASMUSSEN

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PREFACE

THE first edition of the present book appeared, in Danish, in 1909, but the form of education and the method of instruction which is here described and of which the results are set forth first began to take shape in my hands so early as the winter 1890–91.

After experimenting for a few years I published an article in the Danish educational periodical *Vor Ungdom*, in which I laid down as the programme of instruction in zoology and botany that the pupil "shall become an *observer* in the open, that he shall learn to note not only the structure of animals and plants—morphology—but also their mode of life—biology—and that he shall *understand these in their connection*. Secondly, when he has acquired a number of details, he shall learn to *arrange* these in a natural manner so as to obtain a comprehensive survey; and all this is to be done so far as possible on *his own initiative* and with *his own resources*. Each pupil is to become a *naturalist on a small scale*, a *scientist* if one will."

As far as I can see, there is here expressed, as regards biology, the leading principle in that vital pedagogic movement of the most recent time which expresses itself in the ideals variously termed "The New-European School," "The Free School," "The Dalton School." Different as these schools may be in other ways, they have

this in common that they seek to enlist the pupil in the work of ordering education and lay stress on the encouragement of initiative and first-hand work. But this tendency has been the cardinal factor in my scholastic work since the beginning of the 'nineties ; and in the present book I have sought to show how the investigation of nature can be carried on in a school, and to what results it can lead.

THE AUTHOR.

January, 1929.

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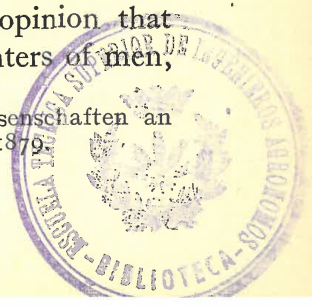
CHAPTER I

SHORT HISTORICAL SURVEY

IN the Middle Ages there was no natural science properly so called, and, therefore, natural science for this reason alone played a very small part in the education of children ; but besides this, nature, even naïvely considered, enjoyed very little regard in consequence of the spirit of the age. Natural subjects were admitted into school curricula merely for the sake of practical utility or from religious motives.

An illuminating example of the standpoint of that age is provided by Rhabanus Maurus' work " De Universo," in which he compiled an abstract of his time's knowledge of nature ; and during his rectorate at Fulda natural science may possibly have been a subject of instruction with this book as basis. If so, it was a natural science far enough removed from nature, as a couple of quotations from " De Universo " will clearly show. One passage runs thus : * " The giants are hermaphrodites. Their sex is uncertain ; but it is an erroneous opinion that before the Flood the angels loved the daughters of men,

* Stefan Fellner : " Compendium der Naturwissenschaften an der Schule zu Fulda im IX Jahrhundert." Berlin, 1879.



and that the giants are the fruit of this love."* In another passage we read: "Pythagoras states that a serpent is formed from man's spinal marrow. But are we to believe it? It would be indeed a reasonable thing if a serpent was produced from man in death, seeing that the death of man was caused by a serpent." Concerning salamanders we are told: "Of all poisonous animals the salamander has the greatest power; for it murders many at one time. When it climbs into a tree, it poisons all the fruits of it and [thereby] kills all who eat of them; and if it falls into a well, its poison kills all who drink the water. The animal itself resists the power of fire and lives in the midst of flames without pain; not only is it not burnt, but of all animals it is the only one that can extinguish fire."

Of course "natural science" of this sort could not form the basis of profitable instruction about nature; it is not only untrue to the facts but also extremely unfortunate in point of form. There is no direct research behind Rhabanus Maurus' work. He merely reports a few casual observations of a long-past age, richly adorned by an unschooled fancy, or else pure inventions. The hearing of such tales could not possibly encourage the pupils to become independent observers. Tales of this description must rather have acted in restraint of inquiry.

It was necessary, in the first place, that a true natural science should be created before it could be introduced into school education; and in the second place, that the methods of such science, adapted to the needs of children, should become current in instruction. The history of education shows that the results of natural science entered the school much earlier than the methods of

* See Gen. VI, 4.

investigation employed by natural science, although these methods lie so close to the child's own spontaneous questionings of nature, and although all the *great* writers on pedagogics have maintained the necessity of the child's self-activity being developed in part by the investigation of nature.

Going as far back as Montaigne, we find this writer clearly and emphatically affirming that education ought to be applied psychology, and that the chief weight should be laid on the development of the pupil's formal powers. Although he did not explicitly stress the study of nature, his principles, had they been applied in practice, must necessarily have led to nature being made an object of the pupil's direct study.

John Locke, too, in his "Thoughts on Education" wrote in favour of meeting the child's interests, and in particular of developing its sense-perceptions; and Amos Comenius, who was strongly influenced by Francis Bacon, assigned very great importance to the natural sciences and demanded that education should work through the senses. He anticipated Locke in the assertion that nothing is to be found in the intellect which has not first been the object of sense-perception; and hence he deduced two fundamental rules of pedagogics: The organs of sense must be exercised *first*, and instruction must begin with the physical apprehension of objects, not with the hearing about them. Therefore, men must "learn* as far as possible to obtain their knowledge not from books but from the heaven and the earth, oaks and beeches; that is to say, they must learn to know and investigate things themselves and not merely the observations and testimony of others about them. One then treads in the footprints of the ancient wisdom when one

* "Grosse Unterrichtstehre," p. 137.

draws one's knowledge from no other source than from the originals, the things themselves."

The French Encyclopædists, however, went still further in their demands with respect to the position of the natural sciences in education. Diderot even required that mathematics and the natural sciences should be the central subjects in schools for the young. Rousseau, however, with his "Emile" became a much more important factor in the development of education; and at the present day one of the main tasks of practical pedagogy is to adapt the good and fruitful ideas in Emile's education to the conditions of a school with many pupils in every class, often situated in a large town remote from nature.

Rousseau's chief merit is that with all his power he insists on the child's right to be a child and to unfold his child's nature. Hence may be directly deduced several other of his fundamental principles, e.g., that natural phenomena should occupy much of the child's attention and be directly observed, that the child's immediate interests should be met, that the nearer should come before the remoter, the simple before the composite, that the cause of phenomena, their "why" should be investigated, and that nature occupy the child before mental life. But, of course, not every manifestation of the child's nature and not every one of its interests can be approved and encouraged. Nature is not to that degree better than civilization.

"Emile" became of the very highest importance for the treatment of the natural sciences in the school, even though the foremost pedagogues fell short on cardinal points. Basedow laid quite too much weight on imparting to the pupils a large stock of knowledge, and Salzmann went too deeply into systematics and the

knowledge of species. But Pestalozzi strayed still further from the true path. In his great zeal for the training of reflection by strictly methodical exercises he scented danger in every casual observation, for such might so easily be obstacles to clearness and correctness of ideas. Pestalozzi, therefore, advised, for example, that instruction in botany should not be based on nature itself, since in woods and fields the plants do not stand "in that order which is best adapted to exhibit perspicuously the essential character of each family." Yet, in spite of this error, Pestalozzi raised the natural sciences to a position of greater importance for the school by insisting so strongly on the high value of direct perception. He says with justice: "What have I done for the instruction of mankind? I have established, as the supreme principle of all instruction, the acknowledgment of direct apprehension as the absolute foundation of all knowledge."

Herbart's main object was different, for he regarded it as the essential task of education to provide the child with a large variety of interests, and to establish these firmly. But on this view, too, a considerable rôle fell to the natural sciences. He deemed them, for example, of high importance for the development of children's æsthetic sense. He pointed out, in addition, that the technological element may with advantage be made a bridge leading to the mental sciences.

With Fröbel a new factor entered into the psychological basis of educational practice, in that he laid so emphatic stress on the active qualities of man. In his view it is the desire for action, the power to do, which forms the starting-point when anything is to be made out of human beings. "Genuine human education must, therefore, begin with action; the education which develops must germinate in action, grow in action, found itself on

action." Fröbel is assuredly right in holding that the child's need of activity is its dominant attribute ; and by meeting this need to use the bodily and mental powers the growth of these powers is forwarded. Fröbel is not here in conflict with those who will have the child's interests met ; he merely sinks his plummet deeper into child-nature. One of the chief tasks in education is precisely that of meeting the child's need of action in such a way that it comes in increasing degree to be directed towards purposes which arouse interest and are serviceable to life. There is thus preserved that engaging freshness which is seen in the child busy with its own business ; while at the same time the results of the impulse to activity gain greatly in value through the actions having become rational.

In conformity with this stressing of the need to meet the child's active impulses, Fröbel required that it should be able to immerse itself in observations of nature ; and he avoided the mistake of paying a narrow regard to utility. Besides that, his conception of existence as a single whole led him to emphasize the natural milieu of organisms, and, therefore, to regard the garden, the wood, the meadow, etc., as units which ought to be treated in the elementary study of nature. Starting, finally, from his view of existence as a whole, he ascribed to the natural sciences great value for the understanding of man —a position which, unfortunately, is still far from having gained full acceptance.

In opposition to the too minutely detailed descriptions and systematizations employed in practice, Rossmässler urged that stress should be laid on " true natural history, that is, the account of how organic life on the earth has developed from simple initial forms to its present wealth, the history which in the end allows us to find unity and

ordered coherence in chaotic multiplicity." Later, C. F. Koch and Ziller pointed out that the developmental history of stages of civilization ought to be reflected in the methodical treatment of the natural sciences in the school ; C. F. Koch and Kienitz-Gerloff have besides made the point that the history of the natural sciences should be similarly reflected (historical physics and the like).

In recent English pedagogic literature, Herbert Spencer's book on education is of special importance ; and he gives great prominence, chiefly on grounds of utility, to the value of the natural sciences. As regards method, he is in agreement with Rousseau on the main points, especially with reference to the child's interestedness, spontaneous activity, and desire to perceive directly.

In the works of the most eminent American authors on education we find special traces of Fröbel's influence. His fundamental conception of child-nature, with its strong emphasis on the child's need for activity, has been appropriated by American pedagogues, and made the foundation of their educational practice. This applies particularly to Francis W. Parker, John Dewey and I. Liberty Tadd.

Parker's fundamental view appears from the following passage : " The child is a born worker. Activity is the law of his nature. Helplessness is the consequence of too much help."* The children, therefore, must draw and model in all their subjects in order thus to give active expression to their experiences ; and the natural sciences must play a considerable part. Dewey considers education from a social standpoint and requires close connection between the child's work in the school and the home, in

* Parker, Francis W. : " Talks on Pedagogiks," 1897. New York ; Chicago. P. 254.

the factory, the shop, and so on. Not only the study of nature but also manual work is to play a prominent part, and this not merely for the sake of satisfying the child's need for activity but also as a means whereby it may repeat the history of human development in its own life. He says: "We must make each school into an embryonic community life, engaged in typical occupations which reflect the life of the greater society,"* and in another place: "Connect the school with life outside the school; and all activities or studies are thereby necessarily linked with each other."† Tadd is also a zealous spokesman for drawing, modelling, and other manual work both for their own sake as exercises and for their bearing on other subjects, such as natural history.

Fundamentally, what these American educationists advocate is a rationalization of naïve pedagogy. It aims at allowing the child to use its own powers, in all essentials to acquire the necessary knowledge by its own experience, and to acquire the necessary abilities by imitation. The American writers named above seek to adapt this practice to the needs of a highly-cultivated society by striving to meet the child's interests and impulses to activity in the most rational manner possible. May the efforts of reformers continue along these lines.

* Dewey, John: "The School and Society," 1907. Chicago; New York; London. P. 44.

† Ibid. P. 107.

CHAPTER II

WHAT CHILDREN SAY ABOUT EDUCATION

It is easy to say that education ought to build on the interests and active impulses of children; but at bottom what do we know as yet about these? In pedagogic literature, especially that of older date, it is only to a very slight extent that really direct observation of children has been made the foundation. Psychologists and practical educators have, of course, observed children and on their observations based their theories and methods of education; but this child-study, even in its best forms, has most often been a study from outside. The study of the child from within has been as good as neglected. Children have almost been regarded as dumb, unthinking beings in respect of the education which they receive; and yet a truly rational theory of education cannot be constructed unless it is largely built on direct expressions of opinion on the part of the persons educated.

Among the leading principles of education which have been brought into prominence by the great pedagogues, the psychological principle is without qualification that which plays the really crucial rôle. But it is only in recent times that a methodical study of this subject has been entered upon. Besides, it cannot be taken to mean that *everything* in the child's nature is to be encouraged. If a child is thievish one does not foster this quality, nor yet a child's mendacity, timidity, or the like. A criterion must thus be applied in order to determine which qualities

the educator shall seek to develop and which he shall endeavour to repress.

That on which I here particularly wish to throw light is the effects which the natural sciences, natural history more especially, but also physics and geography joined with astronomy, have demonstrably produced on a definite age-class of children whose initial attainments were of fairly uniform degree. The children were all between the ages of ten and fifteen, and had all attended either " The United Church Schools " in Copenhagen or the Intermediate Municipal School at Frederiksberg. It is, therefore, intelligent city children, mainly from working-class homes, that are here particularly in question. Before they came under my instruction they had been taught natural history and geography, but not physics, in the municipal schools.

There are two different ways in which I have sought to inform myself as to how the natural sciences have influenced these pupils. Partly, I have put direct questions to them and received their oral or written answers; partly, I have observed their varying performance, and for a series of years written down all the observations to which I attached significance.

While the last-named procedure will hardly be opposed on any point of principle, it is possible that objections may be raised against the first. There is no question here of filling up forms drawn up for the study of child psychology, such as are widely used in modern investigations; it is the expressions of opinion, freely given by the children themselves, on the subjects and methods of instruction, that I have collected. This material will possibly not be accepted as the genuine article. Some presumably will think that the children are consciously untruthful from such motives as fear, friendship, desire

for good marks and anxiety to escape bad ones. Others may remark that children lack the maturity requisite for judging the instruction which they receive. Others again may possibly say that questioning of this kind breaks down the children's respect for instruction, and is, therefore, to be rejected even if utilizable experiences may be collected by this means. All these are objections which I have myself met with; but they only show that the objectors have not tried the experiment themselves.

He who wears the shoe knows best where it pinches. So also the child under instruction knows best how the instruction affects it. Most certainly it cannot come forward as a writer on pedagogics, but it feels immediately some of the effects of instruction, and those just of the kind which the observer cannot always catch sight of. A purely objective examination may often tell the physician what the nature of the malady is. A broken leg, for example, is observed directly, and it is of no importance for the cure what feelings the injury causes the patient. With the " medicinal " diseases it is otherwise. Most often they are not very accessible to observation; and the physician must, therefore, question the patient and by the help of the whole symptom-complex determine the nature of the disease, including its cause. But who will reject this method on the ground that the patient cannot himself judge the character of his complaint, still less its causes? Will anyone be bold enough to maintain that the numerous errors committed in diagnosis ought to lead to all such diagnosis being rejected? Everyone will, of course, say that the method cannot be dispensed with but ought to be perfected.

But the discussion with the children of the instruction which the children receive is almost analogous with the physician's interview with his patient. The physician

does not ask : " What disease are you suffering from ? " still less does he ask the patient for a treatise on his symptoms. But he does ask : " Where do you feel pain ? " " What sort of pain do you feel ? " etc., and from the answers, combined, it may be, with his own observations, he comes, possibly, to the result that the patient's diet must be changed. Of this kind has been my own procedure. I have asked my pupils : " Is this or that tiresome or amusing ? What do you like best ? What do you like least ? " and so on ; these questions they can answer just as well as if, for example, they were asked whether they like apples or yellow peas. But, of course, one must not put more into the answers than is there. A child who says it likes peas does not thereby prove that peas are wholesome for children, and just as little does a child prove that this or that method, this or that subject is serviceable to life by saying that it likes the method or the subject. Nevertheless, the expressions of opinion have value both for the psychologist and the educationist. In my own case the pronouncements of my pupils have at any rate led to my continually altering—and improving—my methods.

It was not, however, a deliberate intention to collect psychological material which at the outset led me to question the children, but an almost purely casual occurrence. One day I met one of my pupils in the street ; and when we got into conversation I asked him what he thought about natural history lessons. He answered : " Well, I must say that botany is rather a bore." This answer surprised me, for there had been no noticeable lack of interest on his part or that of his classmates. As the subject had been started, I asked if there was absolutely nothing of interest in botany. " Yes," he said, " the part about insect-eating plants."

On weighing the significance of this answer I came to the conclusion that it was biology that had roused interest ; but on closer consideration I was obliged to reject this view. The true explanation, however, came to light without any provocation on my part, for the boy said to me one fine day : " Botany isn't so much of a bore now ; " and when I asked : " Why not ? " he answered : " Because now each of us gets a flower to look into and pull to pieces. At the start we had only the dry pictures." From this answer I learnt that even so fine pictures as Engleder's " Botanische Wandtafeln " are not enough to capture children's interest. The pupil must have the living plant in his hands.

But this conversation led me, in addition, to understand that my pupils, intelligently questioned, might give me good hints on mistakes and advantages in my instruction ; and I, therefore, began to consult them, fumblingly at first, but gradually with more of method and conscious purpose.

For the greater part I have caused my pupils to answer my questions in writing, by means of letters, or, as they call them, " compositions," on the instruction they have received. Generally the pupils have written freely, much as they pleased. It is better, however, to let them answer quite definite questions, because these are then the same for all. Still, the letter has its own peculiar value, because by its means one often comes to know important things which one would not of oneself have thought of asking about.

Letters of this kind may be expected to rouse strongly hostile comment, and no doubt it will be said, among other things, that they do not give the pupil's true opinions, but are only casual small-talk, with which he has sought to please me or beguile me. Luckily, I am able to prove that the case is otherwise ; for these writings

often contain severely critical remarks on my instruction, and I will quote some of them. One letter runs :

" *Criticism of your Instruction.*

" Your manner of teaching us is generally good. Perhaps, however, it is too lenient, since boys are easily tempted to be lazy, because, as a rule, they take it for granted they can get off by describing the animal or the object they are doing. Then there is another mistake in your method. You don't give marks before the end of the month. So the marks are as a rule unfair, because you argue that if a boy hasn't known his lesson just once, then he's lazy." This letter, by way of exception, had no signature. A fourteen-year-old girl writes : " I don't care so much about zoology [as botany] because I find it such a bore to learn about the different animals." Another girl of fourteen writes : " Yet I must say that at one time the lessons in the second class seemed to me strangely dry." A boy aged ten to eleven says : " I have nothing to complain of except standing up by the desk ; one gets so worried one can hardly stand on one's legs." Another boy of the same age writes : " I don't like the teaching in this school so well [as in his former school]." A boy of eleven to twelve writes : " That time in the summer months when we had botany did not interest me at all, and I didn't learn anything either." Another of the same age says : " Natural history is a tiresome subject," and another writes : " If I am to be honest and tell the truth, not much of what we have learnt has been easy and pleasant for me." Finally, a fourth says : " I don't like natural history because we have to examine so much but sometimes can't see anything."

A boy of fourteen wrote in his letter : " Zoology has always bored me. What makes zoology a bore, I think,

is this, that we have read and re-read the animals so often that we get just sick of them." A boy of eleven to twelve writes : " The reason I don't like sitting in my place and writing about animals or plants is that it's such a bore ; " and one of his classmates writes : " Natural history is sometimes amusing, sometimes a bore ; " another : " I'm not so frightfully fond of natural history [i.e., zoology]," and a third : " To write [natural history] compositions is the most boring thing I know." A girl of eleven, whom I taught in the Intermediate School for four months, writes : " I don't like geography so well [as natural history] ; I think it's such a bore." A girl of the same age writes : " I don't like botany so well [as geography], but," she adds amiably, " I will see if I can get used to botany, though it doesn't suit me." A third says : " I don't like zoology as well [as botany and geography] ; it's such a bore to sit and listen to it." I quote these last pronouncements more particularly because they show that even children whom I have only known for about four months express their opinions with confidence. One can, therefore, believe with much more assurance that pupils whom I have taught for a longer time know me well enough to have full confidence in the reality of the free speech allowed them, and consequently express their sincere opinions on my instruction. Partly for this reason, partly because the letters, as already remarked, sometimes reveal opinions at variance with those which the children knew to be mine, *I regard it as established that children's letters, as far as trustworthiness goes, may be taken as useful material for those who wish to know children's opinions on the instruction they receive.* To these expressions of opinion a greater or lesser value may then be attributed as one will.

From my collection of over two hundred letters there emerges, in any case, a result of extraordinary importance for practical pedagogy, namely, that *we cannot escape illusions if we judge our pupils' real interest in the teaching from the interestedness which they exhibit*. Both from the criticism contained in the letters and from the pupils' oral answers, I have learnt time after time that a class of pupils, who appear to be taking keen interest in the instruction, are not always really interested. This appeared once in a class of thirteen-year-old pupils, when I asked how the class liked geography ; for the spokesman of the class answered : " Geography is so tiresome because we have to know everything by heart." This does not mean that my pupils are required to learn their geography by rote, answer in the words of the book, or the like, but simply that in geography, where it deals with foreign countries, there is no accessible material for observation, as in zoology and physics. Another bright pupil, who was very friendly disposed towards me, once said : " How is it that both geography and natural history have lately been so tedious that we have all of us been ready to fall asleep ? "

Naturally it is not pleasant to have such a question asked ; but it is a great advantage to have such a feeling openly expressed instead of carried about secretly by all one's pupils. It is certain that boredom on the part of the pupils is very often the main cause of their offences against discipline ; and when the teacher does not take care that boredom is brought to light, his zeal sets him briskly distributing punishments for small delinquencies instead of improving his manner of instruction.

Even teaching, which as a rule highly interests children, may become tedious through small errors of method. For example, it is very acceptable to children to be

allowed to put questions on matters remote from the subject of instruction but interesting to them. But it is not indifferent how one treats the questioners. I learnt this once by inquiring how far it was pleasant to put questions to the teacher in this way. A pupil said : " Yes, it is very agreeable, but not when you give long lectures in explanation." It had not occurred to me that I spoke too long on the questions which I had to explain because the children could not answer them for themselves.

Before I deal in greater detail with the letters on my own instruction, it will help towards the understanding of them to quote a series of pronouncements on the instruction given in the Copenhagen Municipal Schools during the 'nineties.

As the writers of the letters were the head boys or girls of these schools, or, at any rate, the cleverest pupils, it is particularly striking that so many of them describe the teaching of natural history and geography in " the other school " as tedious. True, there are some of the writers, especially among the boys, who state that the subjects named were interesting or agreeable ; but they are exceptions. Of 146 letters on natural history teaching only 15 contain direct praise of " the other school's " instruction, while 76 contain complaints. Naturally, the expressions used vary in strength, but it is often reported that the teaching was " a bore " or " not good," and the like. What specially rouses repugnance is the requirement that the lesson should be known by rote. It appears, indeed, clearly from the letters that this demand is not always made ; but in the letters which tell of it there is all the more bitterness of expression. Somewhat more toned down, but still quite severe, is the judgment passed in cases where the teacher has called

for the lesson to be learnt by heart, though he has permitted the pupil to answer in his own words. Besides this criticism of rote-learning, complaints occur very regularly in the letters that the pupils have only seen pictures, and that, so far as natural objects were used, they were not permitted to see them at close quarters, that only the pupils who were up at the desk could see the objects properly. There is nothing about direct nature-study in any of the letters, and there are very seldom remarks on the use of cut plants, still less of growing plants, aquaria, and similar material.

The character of the letters is best brought to light by allowing the writers to speak for themselves. A girl of thirteen to fourteen writes : " In the other school natural history was not at all like what it is in this school. We only had a lesson set for each time, and we were heard in it, and then it was our own affair whether we could understand any of it. We were never allowed to make any discoveries, and so not a single one of us ever gave a thought to natural history." Another of the same age reports : " In the other school we only had pictures to look at, sometimes we had nothing, and it was very seldom we had stuffed animals or butterflies on pins. Then we had nothing explained, we had a book to read in. . . . At that time I didn't like natural history, because I didn't understand any of it." Another classmate writes : " In the other school the teacher told us about quite a number of animals all at one time, and afterwards we had to repeat it ; and then when we could not remember all the teacher had said we got bad marks, and that's not very pleasant." With Miss X. things went thus : " First some pictures were hung up on the board, as there were only a very few stuffed birds to be had in the school, then Miss X. took the pointer, and the pupil

came up that was to answer. We had a book to read at home, and if we did not know each word that was in the book we were told we were lazy. . . . On the whole, I didn't like the lessons at all, for when the hour was over we were no wiser than when it began. Nothing was ever explained, and therefore we had no profit from the natural history lessons." On another teacher's instruction a fourteen-year-old girl writes : " This [natural history] lesson was almost a terror to me. The teacher showed us some pictures in a book and told us a little about each animal, but mostly I sat and slept inwardly during the lesson, and so I never knew anything." With the girls the usual complaint about " the other school " is that as a rule only pictures are shown, stuffed animals and cut plants very seldom, and that the lessons only consist in things being told the pupils and these reproducing what they have heard or learnt by heart. No real cultivation of the pupil's powers of observation seems to have taken place, still less was any attempt made to rouse and develop interest in real nature. That in spite of these errors in method an individual here and there has become interested in natural history does not mean much ; for, as already said, it is the most alert of the children, the best gifted, and the most interested in their school work who come to the " United Church Schools." It is, indeed, surprising that the great majority of these clever children express so much dissatisfaction with the teaching in natural history given by the municipal and corresponding private schools. On the other hand, it is only natural that they should so often draw direct attention to the fact that " they did not learn anything very profitable " and the like, or that they should reveal indirectly that it was not about real nature that they learnt. Take, for example, words such as the following, written

by a girl of thirteen : " I took no trouble at all to learn it [i.e., natural history]. When we went into the wood we did not know the birds we saw," or this remark from a letter by a girl of fourteen : " I thought that the teaching here would be a tiresome, useless waste of time as in the other school ; for I had never been able to think there could be any use in learning that a cow eats grass or that an elephant has a club-foot." The most lacerating criticism is that of a fourteen-year-old girl who writes : " It [natural history] was a tiresome, long lesson in which the work we had had set was repeated by rote at least five times in order to get enough marks . . . therefore the visit to the Zoological Garden, which we made each year, was without the least profit for us."

The boys judge the natural history teaching in " the other school " more favourably than the girls, but yet predominantly without displaying particular satisfaction, and as a rule in terms of severe condemnation. A boy of ten expresses himself very fully as follows : " I think natural history is a pleasant and interesting subject ; but I didn't like it so well at X. school. Firstly, we were not allowed there to come up to the desk to look properly at the pictures and the few animals which the school had ; secondly, we were not allowed to draw the animals and write essays about them at home, and thirdly, the teacher gave us only a little explanation ; we had to read in a book, and if we did not know it [what we had been set], we had bad marks. And in that school we did not learn natural history so well ; because from the pictures we could not see so much as we could from even the stuffed animals. . . . Lastly, if we had a few small animals or some skulls, they were not allowed to go round among us so that we could all see them at close quarters. . . .

When we had a natural history lesson things went as I shall now tell : We were first heard in the lesson we had had set, and if there was then any time left over the teacher told us about the animals, but very shortly. If there was still some time left, the teacher went through the lesson once more. If we had at home some sort of a little natural history collection we were not allowed to take it to school to show the teacher. . . ." A classmate writes : " In the other school we learnt natural history in this way, that we had to learn a piece with a few additions. By this method we were not able to distinguish between two animals that were about the same. . . ." Another classmate writes : " At Y. school we were heard one by one, we had about insects and a little bit about plants. The teacher called out our names, and then, of course, we stood up, and then the teacher named some insect or other, and then we had to recite after the book. We were nearly all of us fond of natural history." This is really surprising ; but his opinion is shared by several others of the same age, though according to the letters they were all taught, in the main, as he describes.

I will quote a particular letter because it shows how interest can be blunted and disappear. The writer is ten years of age, and he says : " In the fourth class [of the municipal school] I liked best the natural history [we had there] of all the natural history I heard in the classes while I went to the municipal school. There, in the fourth class, the teacher fetched something up from the collection, and then we ourselves explained what we could see in it, and when we had said what we could see the teacher explained something about its manner of life and so on. In the third class I didn't like it so well as in the fourth, because there the teacher fetched up some pictures from other classes and gave us some

for the lesson to be learnt by heart, though he has permitted the pupil to answer in his own words. Besides this criticism of rote-learning, complaints occur very regularly in the letters that the pupils have only seen pictures, and that, so far as natural objects were used, they were not permitted to see them at close quarters, that only the pupils who were up at the desk could see the objects properly. There is nothing about direct nature-study in any of the letters, and there are very seldom remarks on the use of cut plants, still less of growing plants, aquaria, and similar material.

The character of the letters is best brought to light by allowing the writers to speak for themselves. A girl of thirteen to fourteen writes : " In the other school natural history was not at all like what it is in this school. We only had a lesson set for each time, and we were heard in it, and then it was our own affair whether we could understand any of it. We were never allowed to make any discoveries, and so not a single one of us ever gave a thought to natural history." Another of the same age reports : " In the other school we only had pictures to look at, sometimes we had nothing, and it was very seldom we had stuffed animals or butterflies on pins. Then we had nothing explained, we had a book to read in. . . . At that time I didn't like natural history, because I didn't understand any of it." Another classmate writes : " In the other school the teacher told us about quite a number of animals all at one time, and afterwards we had to repeat it ; and then when we could not remember all the teacher had said we got bad marks, and that's not very pleasant." With Miss X. things went thus : " First some pictures were hung up on the board, as there were only a very few stuffed birds to be had in the school, then Miss X. took the pointer, and the pupil

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explanations about the animal, bird, or fish that was in the drawing ; and then we had to remember it next time we had natural history. In the second class I think it was the worst I heard in all the classes, because there the teacher himself drew some pictures of flowers. . . ." Another ten-year-old writes : " [In the other school] the only thing was to learn the lesson by heart ; if we could repeat the whole lesson as it stood in the book we were marked ' very good.' But if we could only say what we saw in the picture of the animal the lesson was about, we only got ' good ' or ' fair.' " This complaint reflects real disgrace on the school ; and the grievances which more particularly appear in the letters are that as a rule there are only pictures to look at, that these cannot be seen properly, that the teachers keep strictly to the book and require too much from the children's memory. Further, it is clear from the letters that individual tuition was given everywhere, but often by two to four pupils at a time being called up to the teacher and heard ; as a rule, however, to judge from the descriptions in the letters, only one pupil was heard at a time. In addition, daily marks were given, which is an important matter for the pupils, but often in such a way as to distract attention from the natural history. Hearing the lesson is in general a very essential item in the instruction ; and when stuffed animals are exhibited, " most often only the pupils who are up at the desk to be heard are allowed to look at the animals." Sometimes the hearing approximates to caricature, in that two or more " talked " at once. When the teacher asked about anything " we both answered." But also the teacher's review of the lesson, his account of the animals, seems to have been very much according to a set pattern, without any careful consideration as to how each particular organism might

best be treated. A boy of eleven describes the procedure as follows : " Then [when the hearing was finished] the teacher began to go through some others [animals]. First he said what it was called, how it lived and where it lived, and so on ; but he didn't tell about the animal's colour or . . . ; and even if [a picture of] the animal was hanging on the board we sometimes hadn't the ghost of an idea that that was the animal he was talking about before he told us so [at the end]." Another boy writes : " The collection [of natural objects at the United Church Schools] is quite large, but yet I don't think it is so large as the one at Z. school, which we never were allowed to see anything of." This complaint, that the school collections are not used, was very general.

On physics in " the other school " my pupils have been unable to say anything because they had left before their instruction in physics began. But in their letters on geography-teaching there is much information on the methods then employed in the municipal schools ; and though geography, as still treated in our schools, cannot properly be reckoned among the natural sciences, I will include it here in order to show what errors can be committed and what illusions cherished if one believes that the apparent interest of the pupils, their industry and their competence, are the outcome of real interest in the subject. In any case, out of 33 letters on geography-teaching 18 speak of it as " tedious " or " not good " and the like, while only four of the writers say that geography was entertaining or pleasant. For the better illustration of particular teachers' methods I will quote a few letters. A boy of ten wrote : " We all had a geography-atlas [as in this school] in which we had lessons set. When the hour came in which we were to have geography, a boy was called up to the big board on which

there was hung a map of the country we had had set. The boy was asked how many inhabitants the country had, how large it was, what religion its people had, what race they belonged to, where was such and such a mountain, lake, or town. Then, when the teacher thought it was enough, the boy got a mark and was sent down. The next man came up, was heard and sent down, and so on. When the end of the hour was near the teacher set us a new lesson, and then we were done with geography for that day." A boy of fourteen writes by way of supplement: "If one goes to a municipal school one will at once notice how hard it is to have a book and learn from it by rote. This teaching is much harder [than in the United Church Schools], (1) [because] when one has learnt it by rote one is not allowed to tell it in one's own words, (2) [because] the teacher never tells us what the country looks like, but only goes through the lesson and sets a new one." Quite in correspondence with this is the picture we get from the letter of a ten-year-old who writes: "At X. school I didn't trouble about the geography because it was such a peculiar teacher we had; he never told us anything." Much blunter is another ten-year-old who says: "[Our teacher] was very clever but too lazy to teach us anything. We were hardly ever heard in the lesson and had five lines set seven or eight times. If once in a way we were heard in the lesson we had only to repeat something or other in a breath; he didn't listen to us, and so we could say something that hadn't been set without his noticing it. While we were saying things in that way he mostly sat and read; now and again he would say: 'that's enough.' He never told us anything; and all the time we had to sit and read in our book." A boy of eleven, after describing the instruction in agreement with the above-quoted letters,

supplies the following *unique* sidelight on the geography teaching: "And the teacher wasn't easy-going either; for he always had the cane in his hand, and he would give a taste of it to the boy who didn't know his lesson. . . . At that time I thought it a bore to have geography." A boy of fourteen draws attention to a disadvantage in the usual practice of hearing the boys singly. He writes: "In the other school we were heard on this plan: numbers 1, 3, 5 and so on were heard, right down to number 31, and the numbers 2, 4, 6 and on to number 30. In this way we could reckon out when we were going to be heard, which was a great godsend to the lazy ones." On the whole, the judgment on the geography teaching in the municipal schools was not favourable. One of the writers of letters says: "The teaching we had in the other school was very tiresome, and, besides, we learnt nothing."

Of course, these letters must not be taken as my judgment on the teaching of natural history and geography in the municipal schools. But, assuming that the children have given truthful statements of their views, one learns from the letters that it is not enough to give a few hours to geography and natural history; *that the value of the lessons depends on the method employed.*

On my own instruction the letters are fully informative. *They not only reveal the pupils' general opinion as to how far the subjects—physics, geography and natural history—are tedious or agreeable; they also furnish valuable material for a reasoned judgment on the pupils' opinion of the various methods employed by me.*

But before stating the main results obtained from the letters I will quote a few examples. It is not to be avoided that here and there a favourable verdict on my teaching should occur. These, it is to be hoped, will not give

any offence, especially as severely critical remarks will also be found.

A boy of fourteen writes in his letter: "Natural history has always been a sort of secondary subject for me, because I have always believed (and still believe) that it is not of the slightest use for me in life. On the other hand, it may well be that by learning natural history one learns to keep one's eyes open when out with nature. I also think, therefore, that the arrangement should be for the teacher to go with the pupils, say, every other day [i.e., natural history lesson] either to the Botanical Garden or the Zoological Garden or the Zoological Museum, and the other hours should be used for explaining to the pupils [what they have seen], and then they should reproduce, as well as they can, what they have seen and heard. Certainly a great deal of time would be lost [on the way there and back ?] and perhaps it could not be done because of the other lessons, but the pupils would have practical experience, and they would learn to rely on themselves. Now, on the contrary, they have to rely entirely on books, and the illustrations in books are often badly executed. And because the pictures are not in colour, as they ought to be, it is difficult to recognize [one of the depicted] animals in the reality. . . . It is best of all to see the real animals—but that cannot be managed."

A girl of fourteen writes: "I should like it best of all if there were no marks, for even if one is interested in natural history one easily gets into reading for the sake of the marks, and when the lesson is heard the thought of the marks one is going to get is very disturbing. I prefer it when we are heard singly, because when we are all heard at once one is tempted to think: 'Let that one only answer who can.' I like best describing animals

or plants. I am less satisfied when I am asked about what is in the book, and I cannot describe the animals and plants in the pictures nearly so well as the real ones. It is not only myself but my classmates as well who are glad about the visit to the woods you have promised us. I hope you will not forget that promise. . . ."

Another girl of fourteen writes in her letter: "When I heard, soon after entering the school, that we were to have botany, I was naturally very pleased, because I have always been fond of that subject, and am so still, if only we do not have to 'analyse' flowers too much. I like better to learn more new plants and get to know where they grow and whether they are any use than to find how many stamens or petals there are. I do like this too, but not for too long at a time. With regard to zoology, I may say I am very interested in it. . . ."

Another girl of fourteen says: "But now for the heart of the matter. I will first give my opinion on your natural history teaching. If I use terms of praise, that is my sincere opinion and not empty flattery; if I have some fault to find I rely on your promise not to take it ill. What I particularly like about your teaching is that we are allowed to examine the various natural history objects for ourselves, for I quite agree with you that we ought to learn to use our eyes in the right way, and by examining things for oneself independence is developed. I also like the way we learn to read a lesson; for it is not a matter of repeating by rote, which I hate, but of reading with understanding and reflection. . . . I am very fond of going to the Zoological Garden, because there one can see the animals tumble around properly. . . . I hope that if you can you will take us for the promised walk in the woods. . . ."

A boy of fourteen writes: "When I began to attend

this school I was no lover of natural history, but I came to like it better and better. What particularly attracted and attracts me is essay-writing, because by describing an object for oneself one notices many things that one has never seen before. If one has described a plant one never forgets its name. As regards the drawing of plants and animals, I think it is very instructive; but as I am not good at drawing I don't care so much for it. . . ." Another is more critical, for he writes: "If I am to speak of the natural history teaching in the 'United Church Schools,' I think it has been good; but my interest in the subject has varied greatly. In the fourth class I was most enthusiastic about it, and the reason was that it was something new to see all the animals that were shown us; it was not so in the other school, for there it was only a few badly printed pictures that we looked at. . . . In the third class also I thought it was pleasant to have natural history, for there again there were new animals to see. In the second class it was a kind of up and down. It was a good method. You began by hearing the whole class at the same time. I don't say this because in this way we ran less risk of getting bad marks, but because none of us could sit and be inattentive, as we could not be sure about being asked some question or other. I also think it a good way of teaching to have all the class standing at the desk and being questioned there, because then no one can be inattentive without you discovering it. On the other hand, I have not been worse bored in any lessons than I was in the botany; for in the second class we saw hardly any living flowers; it was only pictures we looked at; it was so monotonous always to see these, and we could not recognize out in the open the flowers we had seen in the pictures. But in the first class it was more entertaining

to have botany; for here we saw the living flowers, and then one does not forget them so easily. On the other hand the lessons in which you told us about Darwinism were tiresome, because I for my part understood nothing of it; and when I wrote you the essay on Darwinism [and the theory of development] it was only what I could remember of what you said, without understanding it. But again I think it has been a great advantage for me and many others that you have said a little to us about the well-known question [i.e., onanism]."

The younger the writers of the letters, the more naïve as a rule are their remarks, as might be expected, when they try to explain something. But as the principal object of the letters is to provide information as to what really interests the pupils and what bores them, and as the younger of them are just as well informed on this as the older, even the youngest pupils' letters are instructive. I will therefore quote a few samples.

A boy of thirteen writes: "What I prefer in this teaching is that we are allowed to see most of the animals in reality [he means in the stuffed condition], which one cannot do everywhere. Standing up at the desk is all very well, but I think it is better to see each animal for oneself [down at one's place], as one can then much better discover something or see the separate parts more clearly. . . . Writing about the animals is something I like very well, because by it one can see whether one has understood the separate parts quite correctly. I also like the not getting marks; not because one can get bad marks, but because when one reads for marks one tries to know the text almost by heart; without marks one looks more at the pictures and can understand natural history much better."

A boy of eleven writes: "A natural history lesson

goes on quite differently from in the other school. First we all come up to the desk, where each boy has his own place. The boys who have brought something to show the teacher lay it on the desk; then the teacher takes it and tells us a little about it. Then the proper teaching begins. If it is an animal we have had about before, we tell about it ourselves; but if it is something new the teacher tells us and asks a question now and then. In this way I have come to be interested in natural history. . . ."

On the geography teaching a boy of twelve expresses himself as follows: "Now I will tell a little of how we are heard in this school and what I think about it. In this school we have an atlas which we borrow from the school, while we have to get our own geography book. We have a little piece set which we learn well but not by heart. When we come to school we are heard, not as we were in the other school, but in this way that you ask the whole class and the boy who can answer shows it by holding up a finger. We never get marks* except at the examinations. In the other school, too, we did not draw maps, but I think this amusing. . . . At the end of every lesson, for about ten minutes, we look at pictures from all parts of the world, which are very instructive and therefore interest me greatly. . . ."

A boy of thirteen writes about physics: "I like physics very much in the way you teach it. The right thing is for us to see the experiments which are necessary and of daily use in life. [He means: which are necessary for the understanding of the physical phenomena of daily life.] But to explain it, as it stands in the book, without knowing how things look, is something I don't

* This is a mistake. Properly, marks should be given once a month. In some particular months I evaded this duty.

think quite right; for when we have experiments shown us and then explain how they look we understand better and do not forget so quickly. . . ."

A boy of the same age says: "What I like best in the nature-teaching is making experiments in my own place, because then I can see the whole properly and also see how the apparatus is put together. . . ."

A classmate of this writer says: "Of the two ways you have of teaching us about nature I like best, staying in my place, because I can understand better when I make the experiments myself. And in these lessons, which for most of us are the most interesting, there is less quarrelling than in natural history [when we stand round the desk] when one annoys another through wanting to see better, and that often ends with the teacher being in a worse temper. . . ."

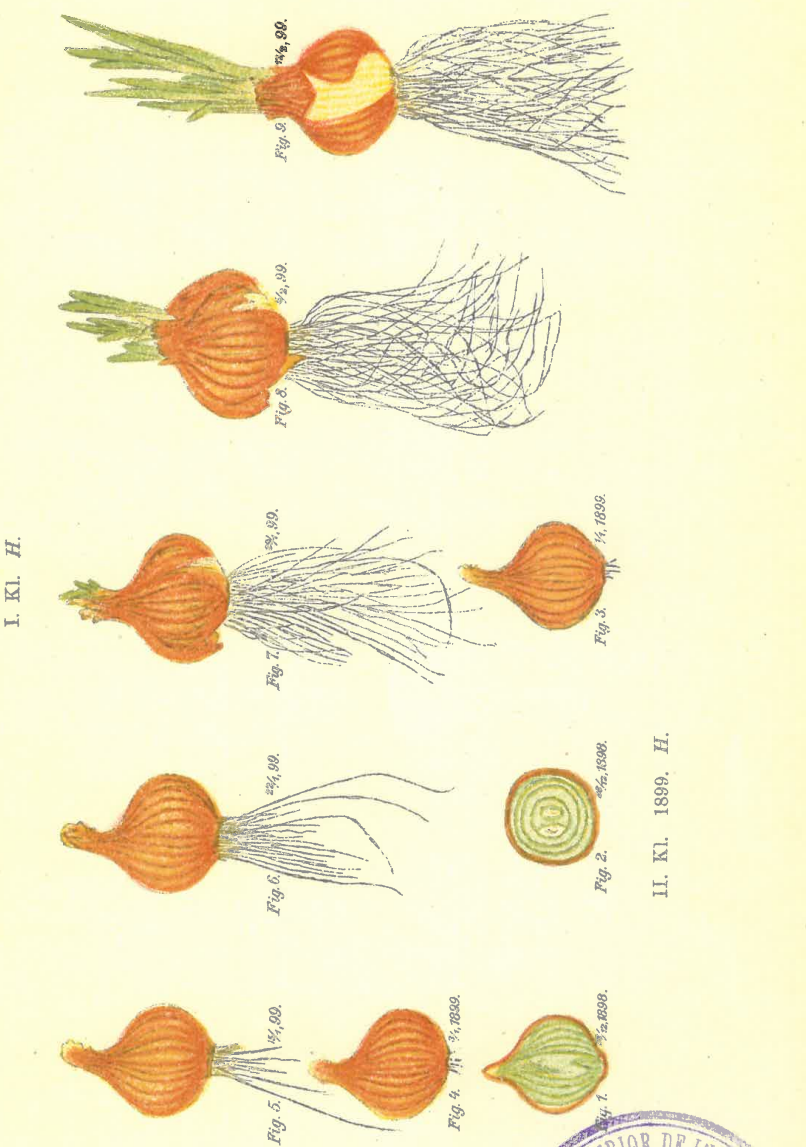
From the extracts quoted it not only appears how particular children regarded the instruction but also what methods I have employed in the three subjects mentioned. I may, therefore, without giving rise to misunderstanding, state the pupils' collective judgment on the methods in question, even while leaving the description and discussion of these to a later stage.

It is a fact of the highest significance, and one hardly to be over-appreciated, that a number of the letter-writers reveal of their own accord that they attach real value only to the direct study of organisms and physical phenomena. It is said, with great variety of expression, that nature is the place where "natural history" in the truest sense ought to be studied. A boy of eleven writes: "One can learn to know the manner of life and development [of the animals] best of all in the free state in nature." A boy of twelve writes: "Doing written tasks is something I like very well, as it is one of the best things for me

to put something in water and see how it grows, or to catch insects and write about them or to have a few frogs or crabs going about alive." A classmate writes: "But botany is what I am most interested in, and I am already happy in my thoughts when I am going to have a botany walk with you in the woods." A boy of thirteen remarks that he took more interest in natural history when he had stuffed animals to look at, "particularly when you began to cut animals up, so that I could see how things looked in a real animal."

It is especially the oldest pupils, aged fourteen to fifteen, who lay emphasis on the direct study of nature, whether pursued in the open or based on physiological experiments with plants or the anatomy of animals. One writes: "The botanical excursions were very pleasant, especially the one by Princess Lane (near Lyngby Lake) to Frederiksdal." Another says: "I am very fond of the beautiful colours and fragrant scents which the plants diffuse in the air, and therefore I reckon a botanical excursion the best of the whole." Another writes more decisively: "It was not till we began botanical excursions and saw living plants, or when we also saw living plants at school, that I liked botany." Still more conscious is the following testimony from another letter: "I have really been interested only in the animals that I could see alive, and that means only the animals that live in Denmark. . . . I also very much like the excursions to the woods when for some hours we collect plants and animals and look at them in their natural state and amuse ourselves [i.e., play] for the rest of the time. The excursion I enjoyed best was the one to Lyngby and Lake Fure, and so I hope we may soon have it again, especially if we start early in the morning."

These quotations are typical of the letters. But I



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have also learnt in another way that direct nature-study has the greatest interest for children and that they are fully aware of it. In the three first classes of the Intermediate School, I one day wrote on the blackboard a series of questions which each of the pupils answered on a piece of paper; and to the question: "Which is best: instruction [in natural history] in the open or at school?" 78 answered "in the open" and 6 "at school." *As the work done in school consists almost exclusively of direct investigations with the help of aquaria etc., the almost unanimous answer in favour of direct nature study is highly significant.*

Next after stressing nature study the letter-writers show, preponderantly, so much the more sympathy with the school instruction the nearer it approaches to the direct study of nature. Although the letters were written freely, without definite questions being put to the writers respecting each particular method, there are 35 who profess interest in natural history essays and only 10 who dislike them; 27 declare themselves fond of natural history drawing, while only one says that he objects to it. On the previously mentioned occasion when questions were put to the Intermediate School classes to be answered in writing, the question: "Which is most agreeable, natural history essays, natural history drawing, or oral instruction?" was answered by 7 in favour of oral teaching, while 58 preferred natural history drawing and painting, 10 natural history essays and 12 both drawing and essays. Thus there are altogether 80 pupils for the last two kinds of direct observation work, while only 7 voted for oral instruction, although it gives much opportunity for direct observation. To the question: "Is there anything which is *specially* agreeable?" 25 answered "Drawing," 18 "Independent investigation,"

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and 8 " Writing essays," while the remainder omitted to answer or wrote about special interests, such as fish in aquaria, or birds, insects, and so on.

The striking difference between the pupils of the Intermediate School and those of the Church Schools in their relative valuation of essay-writing and drawing has no significance attached to it, as neither essay-writing nor drawing has been the same in the two schools named. At the Intermediate School both essay-writing and drawing are done in school, apart from purely voluntary, unimposed homework ; at the Church Schools, on the contrary, essay-writing was voluntary extra work done at home, based on observations made at home. But, taking all together, both at the Church Schools and the Intermediate School essay-writing in combination with direct observation of nature and drawing from nature finds far more favour than oral teaching.

With regard to the different methods employed in oral teaching, the letters and the oral communications of the pupils also supply interesting information. The procedure preferred by the pupils is that of what might be called desk-conversations. The pupils stand, partly on the floor, partly on stools, round the teacher's table, so that they all have the object of instruction, stuffed animals, aquarium, or the like, at close quarters. They are questioned as in class-teaching, but as they are so close to the teacher the instruction comes to be a conversation. Voices are kept low ; questions can easily be put and answered. The object spoken about can be observed by all at the same time under fairly equal conditions. A single writer* has attacked the " class-conversation " and said that it " marks a step backward," but so far as his polemic is directed against what I have termed class-

* Dr. Ernst Kaper : "Den daglige Undervisnings Form."

conversation, more particularly desk-conversation, it rests on a complete misunderstanding. Dr. Kaper thinks that the teacher " addresses his questions to the whole class and lets that one answer who likes." As everyone can see, I have not written that things happen in that way, but only that the instruction almost takes the form of a conversation. Nothing prevents the pupils from making signs as in " class-teaching " and the teacher from pointing out the one who is to answer. With superfluous explicitness I wrote : " But of course conversation in school must not mean several talking at once or unseasonable interruptions. . . . The conversation must be directed by the teacher." If polemics were desired, the correct procedure would presumably be that the critic should first gain by direct investigation the knowledge of how " class-conversation " worked out in practice.

The girls, whose temperament is more toned-down than that of the boys, even when they are looking at something interestedly do not complain much about being put out by standing at the desk, and for the most part they express themselves in favour of this. They give reasons as exemplified in the following : " I like best standing up by the desk ; because we can then look closely at the different animals ; and there is the advantage that we get a sight of all the animals, while not all the animals can go round the class when we sit in our places." On the other hand, the boys, among whom there are always some who out of keenness, or for other reasons, readily create disorder, very often object that they get tired by standing round the desk, though for the rest they quite appreciate seeing as well as possible. A boy of eleven writes explicitly that he likes my method best " because with you we are allowed to come up to the desk

whether we are heard or not, which we were not allowed to do in Mr. X.'s class." Another boy of eleven supplements the defence of standing by the desk in these words: "Up there it never gets so tiresome, and one never gets so drowsy as when one sits below on the bench. Besides, when standing up by the desk one gets a better sight of the animals, especially if they are little ones such as frogs, and one learns much more than one does in one's place, because then it is not always that one's thoughts are directed to the matter being talked about, since one has a chance of playing with something or other." A boy of thirteen writes: "In natural history I like best standing by the desk, because then one can get to know [i.e., to see] much more than there is in the book." A classmate, however, writes: "When one stays sitting in one's place [writing about an animal] one doesn't get squeezed as when one stands up at the desk," and another one: "I think, however, it is best to see each animal for oneself [in one's place], for then one can much better discover something, and one can see the separate parts more clearly. Up at the desk it is not every time that one can see, because those in front shade the object with their heads." A fourth is still severer in his indictment: "I don't like standing up by the desk, because one gets pushed and shoved so that one simply can't hear what is said."

The fact that in spite of these drawbacks the voting in the classes has nearly always been on the whole in favour of coming up to the desk, taken in conjunction with the reasons advanced by particular pupils, shows how great an interest children have in observing well.

When the children have the choice between class-instruction and individual instruction during which they remain in their places, they prefer the first unconditionally.

When the object used for instruction is a picture, e.g., of an elephant, a lion, an ostrich, a palm, or the like, and when the pictures are large enough to be seen by all the pupils from their places, class-instruction has nearly always been employed; and it is preferred by a greatly preponderating majority of the pupils.

A girl of fourteen writes: "[I prefer class-instruction] because then everyone's opinion can come out, and besides that, we are keen on getting our hands up first and giving clear answers. But if we are heard separately we only exert ourselves for the moment we are up, the rest of the time we sit bored; and then when you put questions to us we often answer without interest. . . ." A boy of fourteen writes: "I prefer class-instruction most heartily, because when a couple of boys are up at the desk another one is much readier to drop out than when the class is all heard at the same time . . ." and so on.

In the "United Church Schools," the classes of which contain about 30 pupils each, conversations were held on the methods and a vote taken on the method which the pupils preferred. The result was that one vote was given for individual instruction in the fourth class, six in the third, and ten in the second: all the other pupils in each class voted for class-instruction.

In the three "first" classes of Intermediate School, corresponding to the fourth class above-mentioned, without any preceding conversation on the methods, the voting was 81 for class-instruction and 4 for separate instruction.

The relatively few pupils preferring separate instruction base their preference as a rule on such grounds as that "in this way one gets a mark," or that in their opinion "this way is fairer." Hence, in the Intermediate

School, where marks are only given quarterly, it is probably in part for this reason that there was almost unanimity on the advantages of class-instruction.

In geography, which offers much less favourable conditions for direct observation than natural history, while on the other hand wall-maps, large globes, large pictures, and the like, may be seen at the same time by all the pupils, there is a decided preference for class-instruction, supported, naturally, by the same arguments as in the case of natural history.

In physics, on the other hand, it is otherwise. As there was no physical laboratory in the " United Church Schools " when I was a teacher there, and the instruction had to be given in the general classes, my letters contain nothing about laboratory exercises. But they discuss three other methods: (1) Separate instruction with experiments conducted by the teacher with the help of a couple of pupils; (2) Desk-conversation with teacher's experiments aided by pupils; (3) Independent experiments made by the pupils using the school apparatus; they sit in their places and work together in pairs. These methods were practised on the plan of first going through a lesson by one of the first two methods mentioned above, then repeating it by the last. It is unquestionably this third method which suits the pupils best. Of 21 letter-writers on physics-teaching 19 say that they like best making experiments for themselves, while 2 prefer the desk-conversation, and not one defends separate instruction.

The combined result of the pupils' expressions of opinion, in letters, in voting, and in conversations, is that in natural history they place the methods in the following order: direct nature study, drawing and painting, essay-writing, desk-conversation, class-instruction, separate instruction,

and that they complain of the teaching when they see only pictures and when they have to learn the lessons by heart, especially if they are required to repeat the exact words. In physics, independent experiments have the preference, then comes the desk-conversation, and after that class-teaching; separate instruction is least acceptable. In geography, studies in the open are most highly valued, next drawing and painting maps in school hours, after that looking at geographical pictures, and then class-conversation; least favoured is the hearing of the pupils separately, and as in the case of natural history there are complaints about learning by rote.

CHAPTER III

NATURAL HISTORY DRAWING

JUST as my systematic questioning of my pupils originated in my casually putting a question to one of them, so natural history drawing grew little by little out of my daily practice.

The first impulse towards laying weight on drawing came in the winter, 1890–91, when I was deputizing in one of our Latin Schools. In all essentials I copied the instruction which in my own time I had myself received in the Latin School ; and as my teacher laid much weight on his pupils looking at the pictures in the zoology and botany text-books, I also tried to induce my pupils to familiarize themselves with the pictures in their books. The attempt was at first unsuccessful, and I then required the pupils to copy the pictures, either on tracing paper or in a freer fashion. In this way I could make sure that they had looked at them.

Primitive as this drawing was, it had importance not only for the pupils but for me as well. I came to observe in how small a degree children of ten to twelve are able to understand a picture. Often, as shown in Fig. 1, they drew an insect's legs above its wings, as if the legs were attached to the back, or made similar mistakes. The drawings often betrayed defective

observation in other ways, as in the case of the number of segments in the abdomen of a dragon-fly, etc.

In the Latin School, however, I had not the opportunity to make any special progress as my deputyship only lasted three months ; but when I began to teach natural history in the " United Church Schools " I continued both my observations of my pupils and my attempts to improve my methods, including drawing.

Instead of letting my pupils copy the pictures of the text-book, sometimes even on tracing paper, as at the Latin School, I now got them to draw and paint from well-coloured wall pictures of animals. This was a step in advance ; for the drawing which they copied was now coloured, and that awoke increased interest. This appeared from the fact that the pupils not only drew with great zeal during the lesson hours, of which as a rule they had one each month, but also in many cases drew and painted at home. As an example of the best results obtained, I append Fig. 2, which was drawn at home by a boy of fourteen.

Fig. 1. Copy of a figure of a bee, drawn by a boy of 11, 1890.

Once when I showed an expert some samples of drawing and other work produced by my pupils, he urged me to continue the drawing exercises, but recommended allowing the pupils to draw from nature. This was something I had never tried, because I took it for granted beforehand that the pupils were not equal to the task, and because at that time I had not realized how little it matters whether children are " equal " to

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the problems we adults set them to solve, in that degree which we regard as the standard. However, I took up the challenge and tried to get the pupils to copy the stuffed animals belonging to the school. Here, to begin

Fig. 2. Copy of a figure of a goose, drawn by a boy of 14.

with, I encountered the pupils' preconceived belief that "it is too hard"; but by letting the most competent draughtsman make a beginning I gradually coaxed them all into the direct reproduction of nature. Having once reached this stage I soon made rapid advances, for both the pupils and I became increasingly inventive in

the matter of subjects and their treatment. Thus one day a boy of ten came with drawings of a flower and a leaf, by the side of which he had pinned the originals—to show that he had drawn from nature. From this I got the idea of letting the pupils draw faded, fallen leaves and the like, which they fastened with strips of stamp-edging by the side of the drawings. In one lesson a boy hit on the idea of cutting through an apple which he had drawn; after that I requested the pupils to cut through the fruits painted and drawn by them; and in many ways this released new initiative. Fig. 3 shows an analysis of this kind; and as far as I know it is the first drawing of this kind. Another time a pupil was drawing a lilac branch with buds, and thought of adding a much enlarged figure, giving the two topmost buds of the branch in detail; this too became the starting-point for good imitations. A unique but amusing example of the pupils' initiative is a ten-year-old boy's drawing of a polar bear in the Zoological Garden. There are other ways, too, in which the pupils' initiative has found expression. In *Vor*

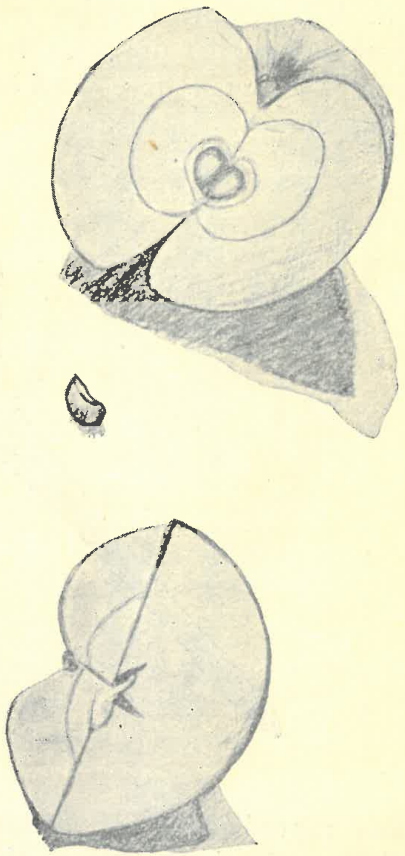


Fig. 3. Section of an apple and a seed, drawn from nature by a boy of 14.

Ungdom, 1900, I reproduced some water-colours of sprouting Spanish onions (here repeated in two of the coloured plates), together with, e.g., black-currant twigs and horse-chestnut twigs with their buds bursting; these and similar drawings, for instance, of germinating seeds, the pupils have often brought, together with long compositions. In the article referred to above there are

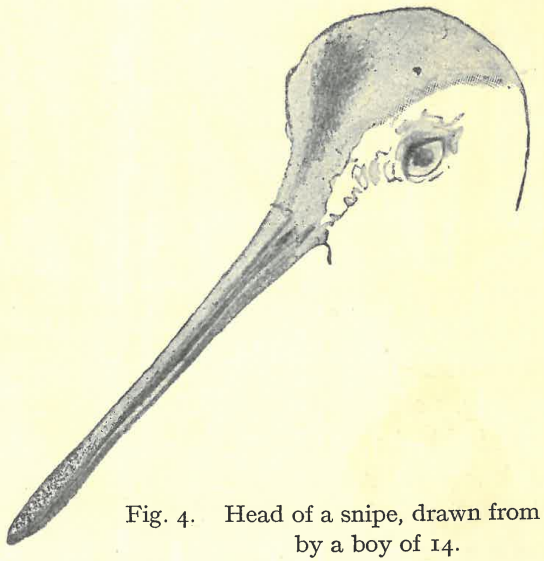
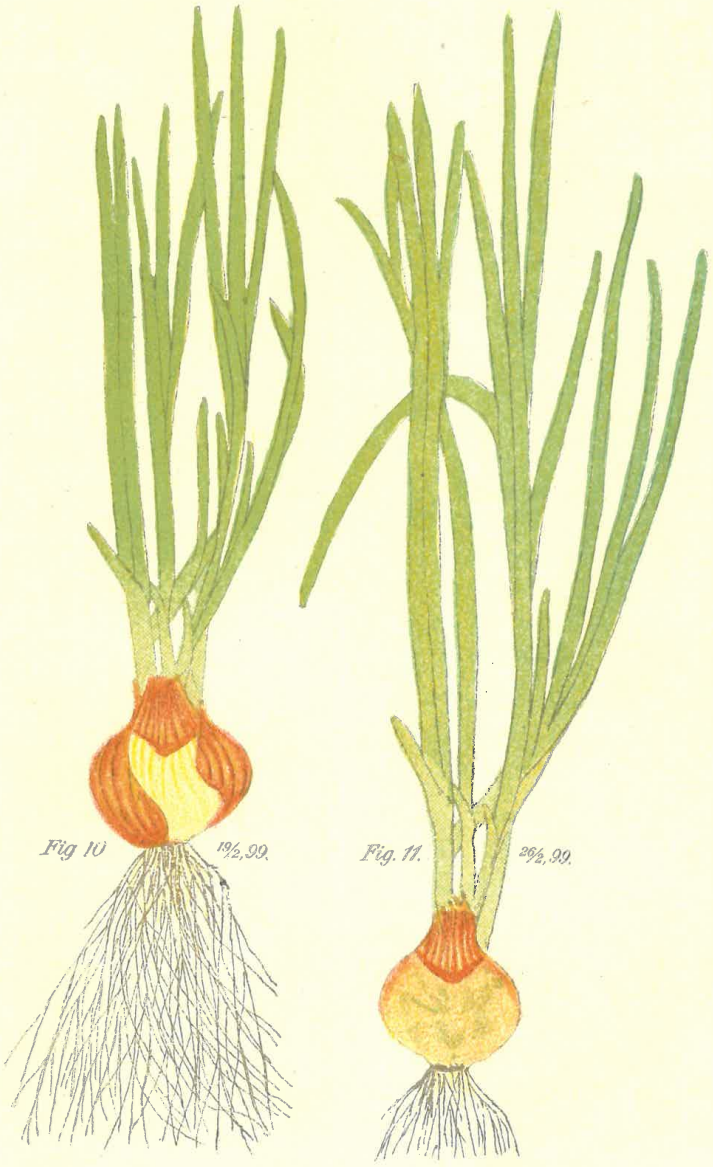


Fig. 4. Head of a snipe, drawn from nature, by a boy of 14.

also reproductions of drawings illustrative of various plants and animals. Here, therefore, I only give a single figure exemplifying the *best* results obtained. The snipe-head, Fig. 4, in point both of liveliness and attention to detail (e.g., the form and covering of the beak) is unimpeachable, particularly when it is remembered that it is the work of a boy of 14. An aloe painted by a boy was excellent in every respect—except with regard to the flower-pot and especially the saucer, which



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was particularly remarkable, seeing that the drawing-instruction of the " United Church Schools," which was admirable, considered in relation to its object, essentially consisted in letting the pupils draw such forms as truncated cones and the like (flower-pots, saucers). The pupil, who was attending the leaving class, was one of the cleverest in this school drawing—but, left to himself, he painted the plant correctly in the main but the simpler forms wrongly.

Besides improving the drawing exercises methodically, by availing myself of the pupils' initiative and the resulting devices, I amended my procedure by the help of experience gradually gained in other ways. Among other things I learnt that at the beginning of instruction it is best to use flat or nearly flat objects, such as fresh or withered leaves, butterflies, stuffed fish, beetles and other insects, shells of shellfish, sections of fruits, roots, stems, and other parts of plants. Gradually the more difficult objects may then be drawn and painted, e.g., stuffed birds, mammals and reptiles, flowers, etc.

But in the teaching of natural history drawing it is not nearly so necessary as in general drawing instruction to proceed always from the easier to the more difficult. The main thing is that the pupil must believe himself equal to his task and have a living interest in it. In a far higher degree than the formerly practised drawing from geometrical models, plaster casts, and so on, natural history drawing meets the child's involuntary impulse to draw and its naturally-formed drawing-technique. Even children of eleven to twelve have not entirely grown out of the primitive manner of drawing, which I need not here particularize.* They sometimes take

* See on this V. Rasmussen : " Child Psychology," II, " The Primary School Child " and " The Intermediate School Child."

considerable liberties with the model when it does not fit in with their purposes. One day a boy of eleven had to draw an apple which was lying on the table in front of him ; but when I came to look, he had drawn a pear. I asked : " How has this happened ? " and received the answer : " I thought it had such a nice shape." In another lesson one of the best pupils was painting a tulip in a flower-pot ; but instead of reproducing the flower-pot before him he painted the handsomer model used by the drawing-class—from memory. But the essential point is that the children should have an outlet for their inborn need to use lines and colours for the reproduction of their direct impressions of nature. If only this need is met, the work itself gives occasion, as the children come to look at nature in a more and more " grown-up " manner, for them to reproduce it in continually increasing agreement with the adult's conceptions. The old-fashioned drawing instruction was, on the other hand, unpsychological because it simplified, " analysed," the phenomena. It was, therefore, also tedious to the pupils, even if for various reasons they worked assiduously in the lesson hours. And how many draw prisms, pyramids, truncated cones, and the like, of their own accord at home ? In school hours, too, there is a striking difference in the children according as it is ordinary drawing or natural history drawing that they have. In lessons of the first kind they work perseveringly, behave nicely and get a great deal done. In natural history drawing their nature breaks out explosively.

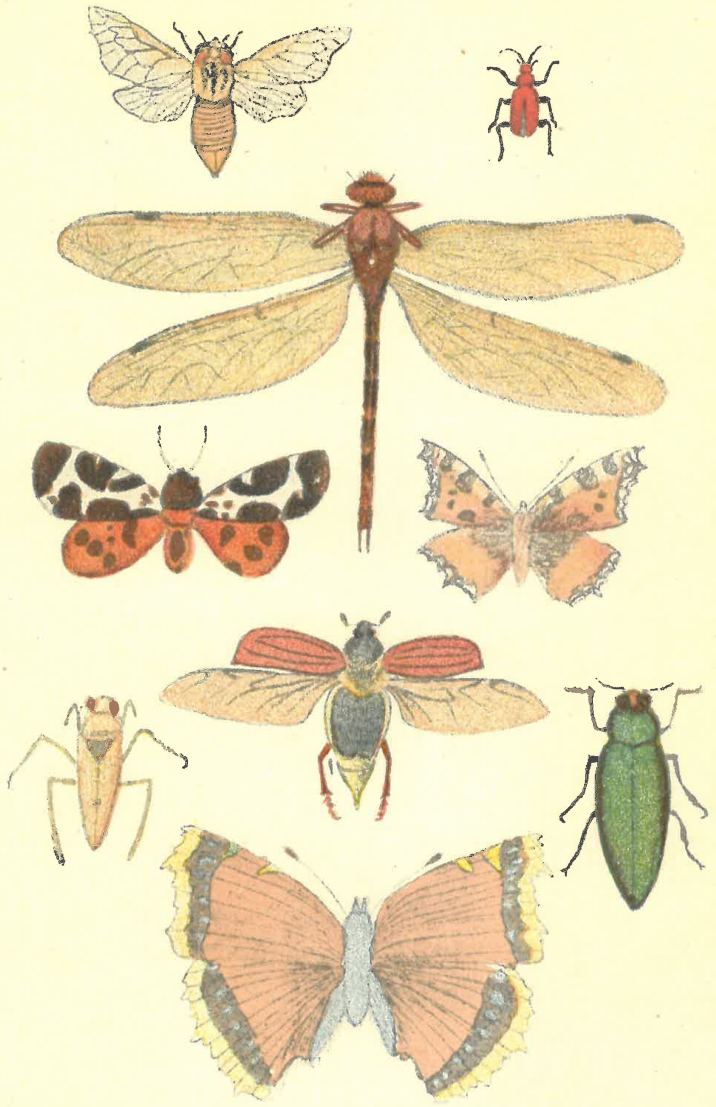
But if we look a little more closely into the natural history drawing of the children we see that it has importance in many other ways than as a means of satisfying the impulse to draw.

Natural history drawing is among other things a source of æsthetic enjoyment and an aid to the development of the æsthetic sense. When children are given a flower, butterfly, beetle, or the like, it is usual for them to exclaim : " Oh, how pretty ! " I often see them contemplating the objects long and lingeringly before they begin to draw ; and their expression reveals that this is not intellectual observation but an æsthetic enjoyment of the object. With this agrees the fact that when choice is allowed children prefer the animals which are most æsthetic—according to the standard of a child. It is, in particular, the most highly-coloured butterflies and beetles that are the favourite objects for drawing, as the swallow-tail, the admiral, the peacock butterfly, buprestidian, lady-bird, and so on, while those of duller hue are as a rule disdained.

It is, of course, an advantage of no little value that natural history drawing thus gives an opportunity for æsthetic enjoyment in the contemplation of the object. I greatly doubt whether the models formerly used in drawing instruction could have had much importance in this respect. Drawing copies hardly enter into consideration, nor yet wire figures nor wood and cardboard models of prisms, pyramids, cylinders and the like ; and it is also highly doubtful whether the tedious plaster ornaments awoke the slightest degree of æsthetic joy and sense of beauty. The colours with which the pupils were commonly allowed to cover their drawings gave them no great occasion to develop their sense of colour. Painting a stool green or a flower-pot yellowish-brown doubtless adorns a drawing in the eyes of a child, fills up the spaces between the lines, and thus meets in some degree the child's spontaneous style of drawing, but a true pleasure in colours and a strong desire to reproduce them in drawings will hardly arise unless the objects used

as models naturally bear the colours which children like. But this is the case more especially with natural objects, such as leaves in their autumn colours, fruits, flowers, sprouting onions and tubers, butterflies, beetles, birds, and mammals.

Nor did the old-fashioned drawing instruction give the pupils' sense of line and form so favourable conditions of growth as natural history drawing. The adult, the drawing-master, the syllabus, etc., have analysed existence too much, so that for children in lesson-time it becomes as a rule something quite foreign. Where does one see these perfectly regular cubes, cylinders, and the like? Only in the analysis of, say, a church tower. Possibly one does here find prisms and pyramids and the rest; but from this it by no means follows that children ought first to learn to draw the analytical elements. *We ought to follow the natural path of development—allow the children to draw without analysis and incorrectly, but in such a way that they amuse themselves by it and become engrossed in it.* If then we can point out faults in the drawings and suggest methods by which the faults may be avoided, we shall have our pupils' ears. *This terror of the incorrect which is revealed by most educational practice is one of the many evidences which show how small a foundation in psychology our education still possesses.* In my natural history drawing exercises I allow my pupils in the main to judge for themselves the value of their work. If a child comes and asks: "Is this good enough?" I answer as a rule, but in varying form: "Yes, if you, yourself, like it." It is only very obvious defects to which I draw attention. *One must not kill interest by too adult a standard of criticism.* One should judge like a cleverer child, not like a critical specialist in draughtsmanship. And when a pupil has frequently



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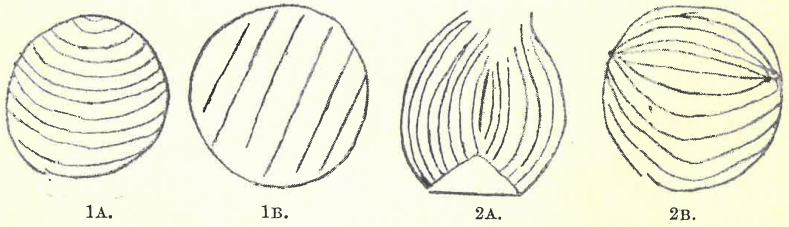
drawn butterflies and other natural history objects, even if his results are defective he has not only had rich opportunity to develop his sense for beautiful lines and forms, but in addition he has with lively interest practised himself in the reproduction of them.

It may possibly seem something of a paradox, but it is true, nevertheless, that the old style drawing-instruction tended rather to wean children from drawing. Left to themselves they have, as is well known, a technique quite different from that of the school, and, as already said, they do not see daily the models which they draw in school-hours. Consequently, it does not strike them that drawing and painting are always and everywhere so very interesting things; and as they gradually grow up their school drawing even kills their own primitive child's-style drawing. In any case I have myself passed through such a phase of arrested development. As a small boy I drew and painted with great zeal, like most other children lucky enough to possess the materials for it; but the drawing-instruction received at school gave me no incentive whatever to work onward, and my desire to draw gradually died away. Memory-drawings of horses, soldiers, houses, and so on I grew out of; and the drawing-instruction had not started me on a profitable line of work which would have preserved my interest and led to increased competence. This is certainly typical of what happens to most children—both those who receive no drawing-instruction and those who "learn to draw."

Natural history drawing has a special importance of its own in relation to the observation of nature. A drawing is a short and pithy record, made with a few strokes which can be understood, while the same information, given orally or in writing, requires many words, which, in

spite of all possible care, never hit the mark with the same certainty. For different individuals words do not agree in value to the same extent as pictorial presentation, and often, however much they may agree, they cannot give the information conveyed immediately by a drawing. One can indeed describe a snipe's beak and say it is long and thin. But how long? how thin? and in what proportion does the length stand to the thickness? If these matters are expressed in numbers, the description becomes too circumstantial and is not readily visualized. A drawing, on the other hand, gives the facts immediately, supposing its proportions are correct, if only one knows



1A. 1B. 2A. 2B.

Fig 5. Memory drawings of a shallot, drawn by girls of 13.

the ratio its dimensions bear to reality. If, therefore, skill in drawing and the ability to look at drawings were very general, it would be possible to delineate things with much greater accuracy than they can be described in speech or writing.

But everyday observation is extremely superficial, and in particular the ability to remember and reproduce the observations is small. I have frequent experience of this, because while giving oral instruction I allow the pupils to draw from memory on the blackboard. *The perception of how little they remember and how little they are able to draw rouses their desire to observe more carefully and intensively*. Once when some girls of thirteen had to draw the inside of a shallot, the first drew 1A and 1B

in Fig. 5 which were intended for the longitudinal and transverse sections. When I invited the class to criticize the figures, a pupil came forward who drew Figs. 2A and 2B; further the children could not advance. As in

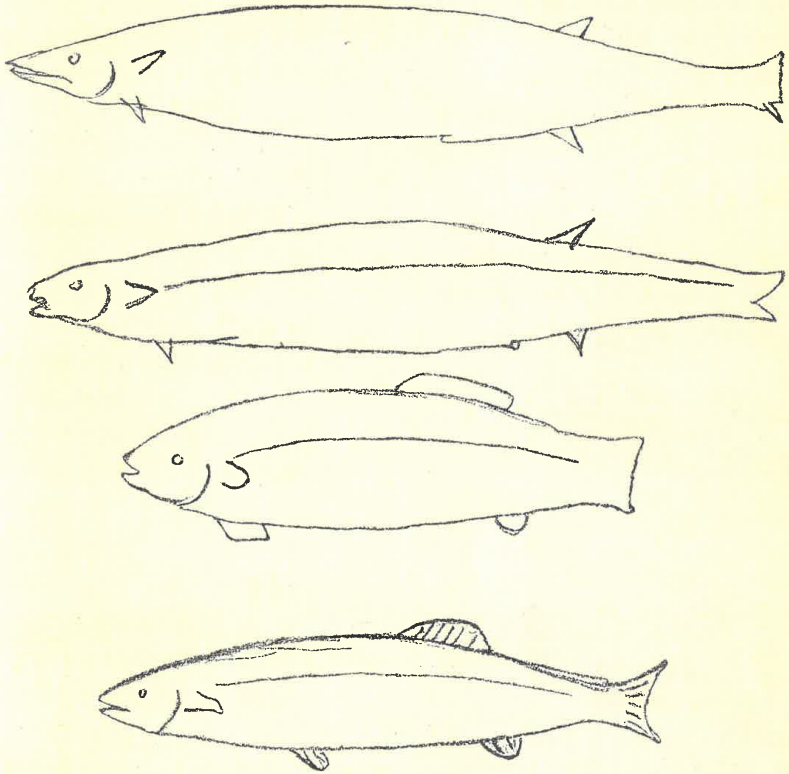


Fig. 6. Drawings of a herring.

copying the drawings I was checked by the children, essential errors cannot have entered into the reproduction. The drawings from memory by boys, which are perhaps better than those of the girls, also show that observation is usually superficial. As illustrations of this I append figures from the "United Church Schools." Fig. 6 shows drawings of a herring, executed by boys of

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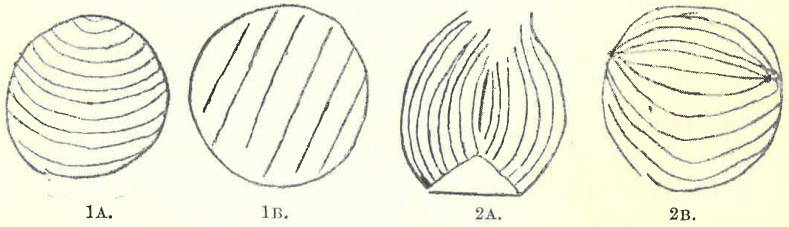

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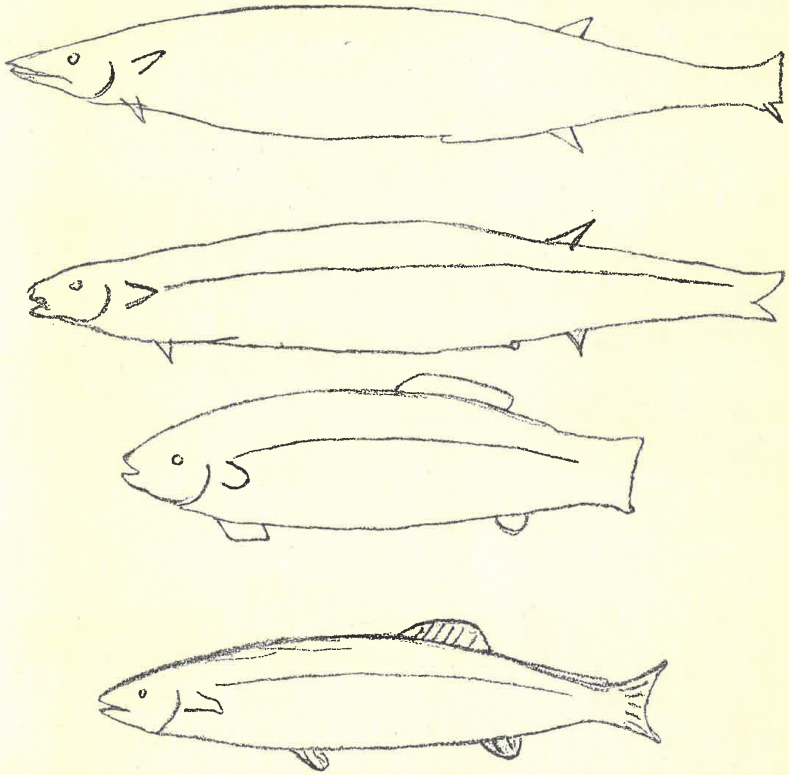

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about 11. Fig. 7 consists of pictures of a cod, made by pupils of about 13, and Fig. 8 represents a cockchafer and was drawn by pupils of about 12.

I also use drawing in chalk on the board for the purpose of bringing out the imperfection of momentary direct observation of nature ; and in this, as in many other ways, I have seen how many illusory ideas teachers form as to the results of their instruction. A girl of 13, who was standing with a hawk by her side to look at, drew its beak as No. 1 in Fig. 9 ; it was not till after criticism from the class that a second girl drew No. 2 in the same figure. In a class of twelve-year-old boys, the tip of a snipe's beak was drawn from direct observation of nature first as No. 1, later as No. 2, and finally as No. 3 in Fig. 10. From these typical examples it appears that the capacity for real observation is highly in need of exercise. *One must perceive one's observations before they can be of value.* "Well, that's how it looks," must be uttered inwardly if the observations are to become a serviceable constituent of experience.

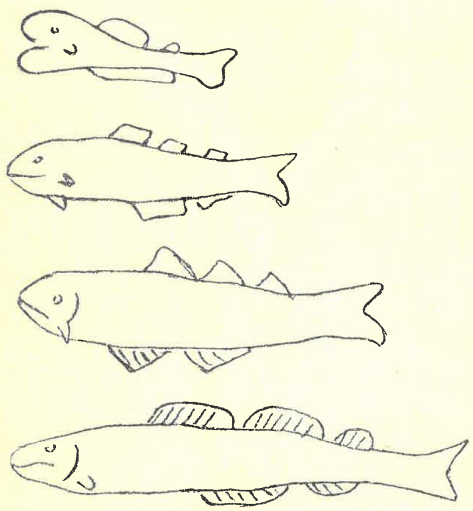

Fig. 7. Drawings of a cod.

The fact that, as already remarked, pupils left sitting by themselves often observe thoroughly and draw details correctly is not really in conflict with the experience that

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pupils standing by the class-table and blackboard to observe and draw acquit themselves badly. *But as this*

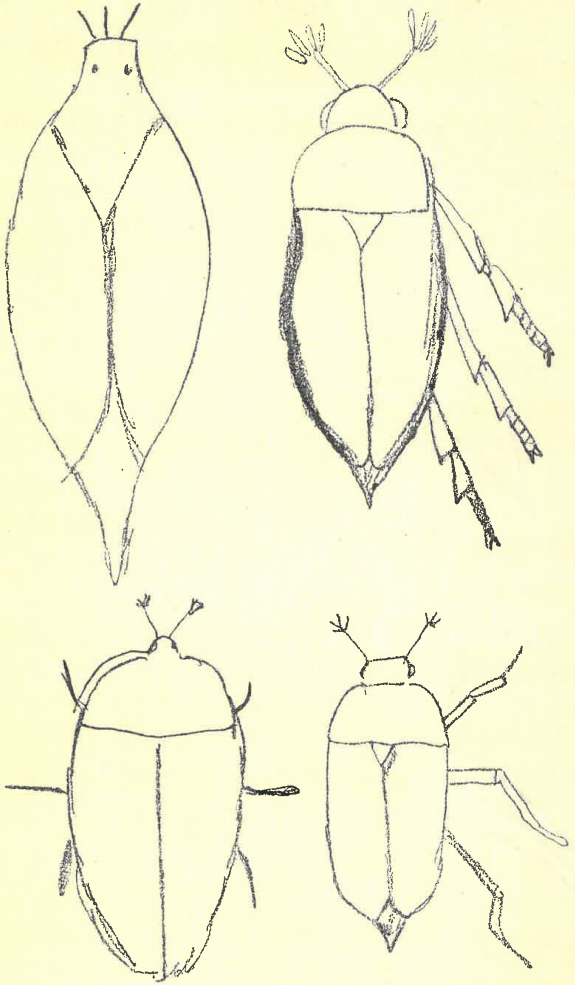


Fig. 8. Drawings of a cockchafer.

last form of observation is that for which the business of life most often gives occasion, the power of observation ought also to be developed till it becomes adequate to such hasty glances at objects.

But in addition to the enhanced power of observation which the pupils derive from natural history drawing, *they also gain a greatly heightened belief in reality and a more intimate knowledge of the qualities of objects than if they merely heard or read about them.*

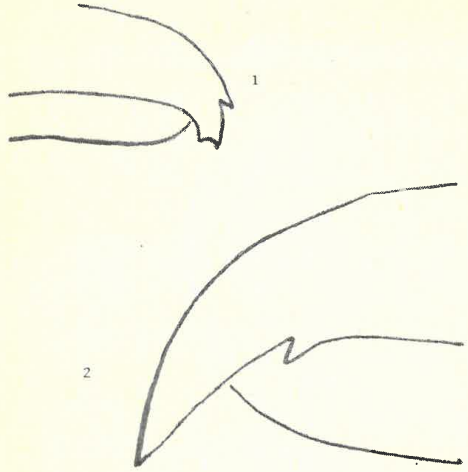


Fig. 9. Drawings from nature of a hawk's beak, drawn by girls of 13.

In 1907 when I became head of the Intermediate School in Godthaab Road, I introduced close co-operation between the subject, between natural history and drawing as a particular case. The school's drawing-master, who originally began with the use of the Andersen models : cube with circle drawn on it and so

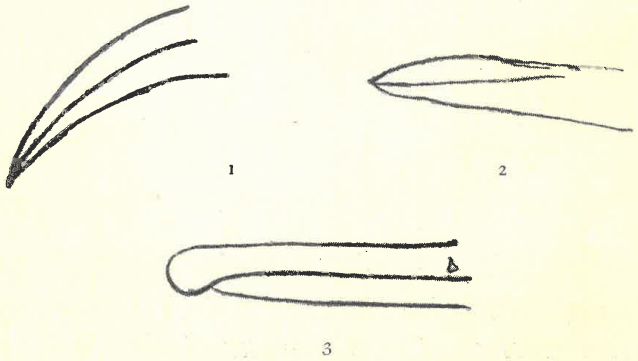


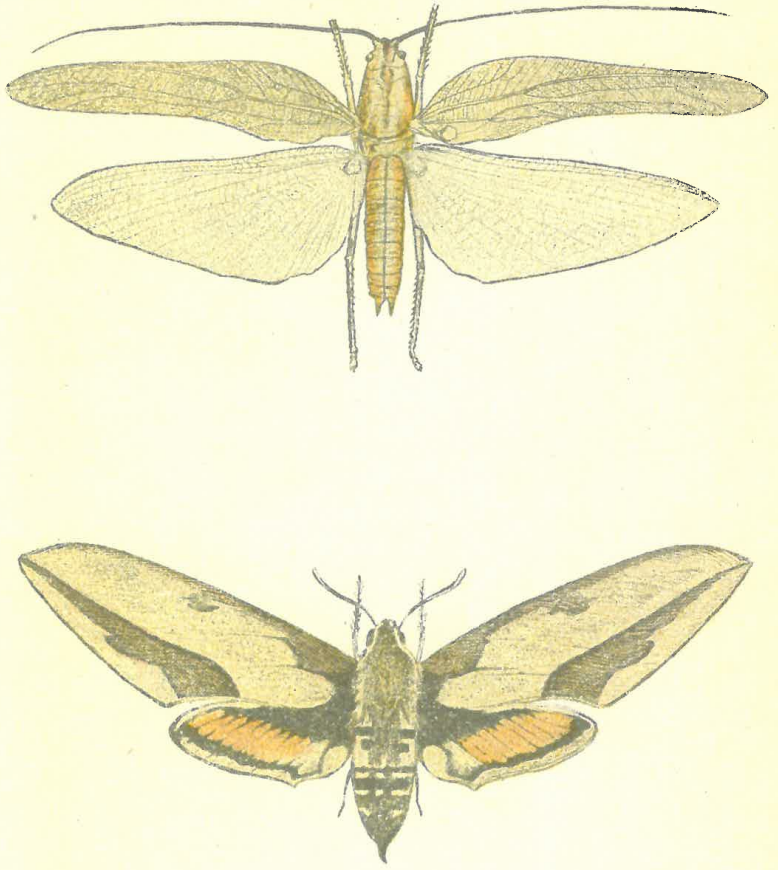
Fig. 10. Drawings from nature of a snipe's beak, drawn by boys of 12.

forth, readily consented to make a trial of natural history models, and in the course of years obtained especially fine results. In the coloured plates here appended may be seen some examples of the work of the first school-year ; but in the oldest class there was naturally much more skill in drawing shown, with regard both to content and to form, as may be seen immediately by comparing the plates, the last of which reproduces drawings from Class IV of the Intermediate School, drawn with the guidance of the drawing-master.

On the co-operation between the two subjects the drawing-master of the Intermediate School thus expressed himself. " I have derived great pleasure and much profit from the co-operation between drawing and botany [and zoology]. As the pupils frequently [yet only once a month] draw in the botany lessons, I have undoubtedly gained by the practice in looking at and reproducing plants which the pupils have had in these hours, and I have learnt that in the 3rd Intermediate class I can present the pupils with really difficult tasks in plant-drawing. The greater part of the class solves the problem satisfactorily. It has also happened that I have taken drawing-objects from zoology, e.g., butterflies, and a cod, and the best pupils have had great pleasure in solving such problems. . . ."

In addition, plant models were often used as a means of raising interest in vases, jars and the like, to a higher level. A vase or jar taken alone may well strike a child as somewhat " dry," but, put a flower or a spray in it, and the vase or jar immediately becomes interesting and is drawn with enthusiasm.

Fig. 11. Jar with cactus. Cl. IV, Intermediate.



Locust and Hawk-moth (Sphinx).
IV M.

ESCUELA TECNICA SUPERIOR DE INGENIEROS AGRONOMOS - BIBLIOTECA - SORIA

To sum up, natural history drawing has the following results: it gives opportunity for æsthetic enjoyment in the contemplation of the object and develops the sense for line, form and colour, it gives the pupil skill in drawing and painting so that he can express himself quickly and clearly by their means, it promotes initiative, meets the child's need of activity and rouses its interest, it carries forward the child's natural drawing and painting technique, it develops the power of observation, it gives occasion for the pupil to acquire thorough knowledge of objects, it develops the power of understanding drawings.

One might conjecture that natural history drawing would also develop the decorative sense and introduce the pupil to the conventionalizing of forms; but as yet I have observed no such outcome of the drawing exercises. One day I showed the children some English drawings, kindly lent me by Miss Henny Forchhammer, among which were some conventionalized plants, intended, e.g., for embroidery patterns. Yet none of the girls in the Intermediate School Classes attempted any conventionalizing or pattern-drawing on the basis of natural objects.

Since natural history drawing, as shown by the letters, the voting, and my observations, rouses children's interest in a high degree, and as it leads to the results mentioned above, I take it as established that it ought to be included as an essential part of instruction in natural history, in drawing, or in both. The subjects will not be treated exactly alike by a drawing teacher and a natural history teacher, unless they are the same person; natural history objects may therefore with advantage be used as models in the teaching, both of natural

history and of drawing.* Moreover, during the last twenty years a sensible development has taken place in the method of drawing instruction, partly in the direction which I advocated in 1900 in *Vor Ungdom*.

* The purely practical and technical side of the matter was dealt with by the school supplying paper and colours and lending out fine paint brushes, with wooden shafts. Inferior brushes with quill shafts are not suitable for use where colours have to be applied in quite small patches, e.g., the blue spots along the wing-edges of the nettle-butterfly. The water-colours were mixed by the pupils themselves when they thought they could manage it; otherwise I mixed the colours myself. Naturally, I did not retouch the drawings, but, as already said, occasionally pointed out the grosser faults.

CHAPTER IV

NATURAL HISTORY ESSAYS

STILL better than drawing as a means of training pupils to become real investigators of nature, is the natural history essay. In *Vor Ungdom*, 1896, and more fully in 1900, I dealt with such essays on the basis of actual observations. For general illustration I will now quote a couple of essays in their entirety, beginning with one written by a pupil in the oldest class who had had practice in composition for about four years.

I gave a boy of fourteen a tuber of a South African plant unknown to me, and on this he wrote:

"At the beginning of May I placed the tuber in a small flower-pot which was nearly full of earth. When I looked at it on the morning of May 13 there had come into sight a small green cone, about $\frac{1}{4}$ inch high. The next day it was $\frac{1}{2}$ inch high, and after this it grew $\frac{1}{4}$ inch every day; and at the same time light stripes appeared along it. On May 16 the cone had opened a little on one side, and I now saw that it consisted of two leaves rolled together, the one inside the other. They then grew $\frac{3}{4}$, and later 1 inch daily, and little by little the leaves unfolded, the outermost first, then the innermost. On May 24 I discovered a little rolled-up leaf inside the inner leaf of the plant, and on May 29 that too was unfolded. When I looked at the plant on June 9 I

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discovered that the innermost leaf, which was the youngest, was the longest, then came the next oldest, which was a little shorter, and lastly the oldest, which was considerably shorter than the others. When I touched the leaves, I heard a crackling sound. The leaves are pointed at the top, fairly thick, and covered with a thin layer of white wax which gives them a disagreeable bluish-green appearance, and which comes off when the leaves are touched. If one were to cut across a leaf the section would have the shape of a printed U.

" One fine day I discovered to my great surprise a long, green point which projected from the middle of the plant. The point grew quickly, and on the top of it there came a green bud an inch in length. Some time afterwards the bud opened, and inside there appeared to be several small buds of the same form as the large one. The large bud was green, but the small ones white. The small ones had a stalk each, which grew and separated [i.e., the flowers did], further and further from each other, and at the place where one of the small stalks was attached to the main stalk there was fixed one of the small leaves which had formed the large bud [outside]. Five flowers came. Each flower consisted of six long petals joined together below ; and inside each petal was a stamen, very like a narrow white leaf with an anther at the end. The anther looks black, but on closer examination it proves to be filled with green dust. In the middle of the stamens is placed the pistil with its stigma ; and everything is white except the ovary, which is green, and the anthers. When the last flower came out I discovered that by the side of an anther there was a large white leaf. In order to obtain fruits I applied to the flowers pollen from a fuchsia. The petals and stamens gradually withered, but they did not fall off ; and the

ovary remained an inch long and was full of wrinkles lengthways. When it was ripe it shrivelled up and at last fell off. Then I put it in a box to plant next year. The whole plant came to be an ell high."

This essay is evidence that training can give a child a considerable measure of the scientific spirit. There are here no hasty attribution of names before the thing itself has been investigated ; and the investigation is throughout penetrating and critical.

As man, so far as I know, is one of the organisms which in the least degree are made the object of pupils' *direct* observation, although one would have thought that here lay the very nearest field of study, I will also quote an essay on man. Sometimes the children have described each other, working in couples ; sometimes a child has observed and described itself, partly with the help of a mirror. The following essay was written in the last-named manner by a boy of twelve to thirteen, who had not received instruction on man in the " United Church Schools " :

" The head of man is long. At the upper part of the head is the forehead, which is vaulted and hard to the feel. The hard part is bone and the front part of the brain-case. On the head is the hair, which is soft and covers the whole of the crown, the nape, and a little of the sides of the head. On both sides of the head is a bone which stands out, and when we chew another bone comes up to it. The nape is also hard to the feel, and the nape bones form the hindmost part of the brain-case. From the nape there goes a bone down to the spine. [In the face are] the eyes. In the outermost part there is something white. Inside this is a broad ring which in man has many different colours. In the very innermost part is a black spot ; and this is the pupil. This

is only a hole in the eye through which the light falls.* When one looks towards the light the pupil is small, but when one looks towards the dark it is large. The eye is longish and pointed at both ends. It is closed by the eyelid, which has stiff hairs on its edge, being drawn down over the eye. The eyebrows are placed above the eye, and on these there are also hairs ; but they lie evenly over each other. [Between the eyes is placed] the nose. Through the middle of the nose goes the nose-bone, which is also the wall between the nostrils. The nose is long and the nose-bone in some people ends in a lump ; this lies then in the middle. The nose-bone is sharp above. The mouth is used to eat with. The tongue is fastened firmly below to the neck-hole, and lies in the middle of the mouth. The tongue is very fleshy and it is used to talk with. [In the mouth are also] the teeth. The front teeth are in man square, and the broadest are in the upper jaw ; and they are very sharp. The corner teeth are like the front teeth, but they are narrower and more pointed. The grinders are lumpy. Right back in the mouth there is a hole ; and when we eat the food goes down through it. We use the ears to hear with. The lowest part of the ear is soft. The rest of the ear is of gristle ; and this is covered with skin. The whole ear has a remarkable form. There are passages and corners round about the ear. Above there is a passage which begins at the middle of the ear and goes up in a curve right into the head. Inside the ear itself is a long passage, called the ear-hole, which goes into the drum. Through this passage sound goes. In this passage there collects a yellow something called ear-wax, which is poisonous. The cheek is a piece of flesh placed at the side of the head . . ." etc.

* Spoken of in zoology lessons.

Children can also cope with more difficult subjects concerned with the natural history of man. After I had told the pupils that they could study the formation of speech-sounds by observing themselves in a mirror, several wrote long essays on this. A boy of fourteen who, no doubt, had heard something about the subject in the Danish lessons, wrote the following essay :

" HOW THE LETTERS ARE PRONOUNCED

" When one pronounces the *a* sound, one has the mouth open ; but it is all the same whether it is wide open or only slightly. The tongue lies still down in the mouth. If one brings the tongue far back in the mouth, the sound comes to be very like *aa*. When one utters the sound *ö* one should have the mouth wide open. The lips are still. If one shapes the mouth just as if one wanted to whistle, and then tries to pronounce *ö*, one gets the *ø* sound instead. If one opens the mouth and sings the *a* sound, and then immediately closes the mouth and points it, as if to whistle, one always comes to sing the *ø* sound. *O* is pronounced with the same mouth-position as *ø*. *E* is somewhere about the same as *a*. In the *u* sound one can notice a sort of little jerk in the throat, because one has the mouth nearly closed, and the air comes out with a jerk. *Y* is pronounced entirely like *u*. When one pronounces the *i* sound one pushes the mouth a little forward. All these letters [!] were vowels ; and in these the vocal cords vibrate and the tongue is not much used. But now come the consonants," etc. The whole essay fills four and a half folio pages.

The natural history essays at the " Church Schools," of which the three quoted give samples, were generally

written at home. The pupils were asked whether they were willing to write an essay to be given up at a definite lesson on the understanding that for the hour in question they would be free to draw without taking part in the lesson. In this way each pupil, with a few exceptions, wrote about one essay a month. Now and again, however, the pupils also wrote essays during lesson-time about cut plants or the animals in the school collection : in addition a few wrote during the summer holidays about the animals and plants which they observed in the country.

When I began teaching in the Intermediate School I resolved to continue the direct study of nature, in combination with drawing and essay-writing, in the highest degree possible ; and as the school opened in June, I arranged the plan of instruction as follows. I first showed the manner of carrying out some of the plant-physiological experiments which are described in my " Botany for the Intermediate School," so that the pupils could see that plants are living things and require certain conditions in order to live ; and each pupil received a few seeds for home experiments and was requested to get from his mother potatoes, onions, etc., so that the pupil could work at home as a first-hand investigator. Next, I took each class out twice to fresh water, where we caught animals and collected water-plants for an aquarium in each class. Some time was spent in investigating this living botanical and zoological material ; and the reciprocal utility of plants and animals for each other was demonstrated by experiments. In the lesson-hours the animal forms were observed each for itself, after being fished from the large aquarium and placed in a jam-jar which the pupils all observed at the same time. They stood round the desk. Before the summer holidays an

excursion was made to Klampenborg. After the summer holidays each class was taken to Søndermarken ; afterwards to Geel Wood, where we observed virgin soil, dense spruce fir forest and beech forest, and in addition collected fungi, lichens, moss, and ferns, and caught small animals. Later, the pupils went to Charlottenlund in November and observed the fall of the leaf, mould, bushes and trees in autumn garb, forms of fruit, the fight between oak and beech, etc., together with a few animals. After this each class went to Frederiksberg Park in December and looked at trees and bushes in winter garb, and after that to the Zoological Garden, where the pupils each looked at their chosen animals.

To suggest to teachers that Sundays and holidays may occasionally be used for woodland excursions is not very helpful ; for one cannot require or expect teachers as a rule to sacrifice their free time for the benefit of their pupils' open-air studies. It should rightly be the school-time which is applied to this as to all other parts of school education. There is therefore hardly anything else to be done than to convince teachers that so rich a profit is yielded by out-of-door excursions that nothing is lost by giving the children a free day now and then for an outing, but that on the other hand they acquire thereby an extraordinary interest in natural history—more correctly, *the investigation of nature*.

General remarks to the effect that so much can be seen in a day are naturally inadequate for this purpose ; but I am inclined to think that my diary-notes on what was observed in my pupils' excursions form an argument powerful enough to remove all doubt as to the utility of natural history outings and the legitimacy of now and again " sacrificing " a school-day to them. These notes, however, were not made for the sake of this demonstration,

but as an aid to the instruction given in the excursions. When the pupils have finished the essential work of observing and finding plants and animals, it is my custom to gather them round me ; and we all then help each other by naming the plants and animals that have been found and what other objects may have been seen. This is a useful concentration of the scattered impressions, and it gives an excellent occasion for bringing home to the children how extraordinarily much they have had an opportunity to learn.

Before the more extensive expeditions the pupils are advised beforehand *what* phenomena they will have the opportunity of observing, or else they are told what subjects of school-instruction they will be able to obtain first-hand information about, e.g., the struggle for life of the oak and the beech, the shooting and the fall of the leaf, etc.

The most extensive expedition was one which I made in June, 1906, with some boys. We took the train to Elsinore and from there walked to Gilleleje, where we spent the night, the next day we drove to Raageleje and walked therefrom to Frederiksvaerk. This last stretch was, however, too long ; some of the boys were not far from falling out of the walk altogether. Before the expedition I told the pupils that they would have opportunity to see the following : (1) Kronborg, (2) Hornbaeck plantation with virgin soil, (3) Gilleleje beach with downs, down-vegetation, foreshore, stranded plants and animals, (4) heather by the road to Raageleje, (5) Tisvilde Wood with older and younger plantations, and (6) whatever else might turn up.

Although it does not concern natural history, I must state that Kronborg interested the boys in a high degree. Something of its aroma was, however, destroyed by the

stupid witticisms which the otherwise competent guide thought himself bound to utter ; all the same, the boys were attracted in the highest degree. Among other things they received an indelible impression of the cruelty formerly practised against the prisoners in the flat-iron prisons of the casemates. One of the boys said of this : " When Mr. N. [in the history lessons] tells us about the prisons it doesn't sound so bad ; but here it looks serious."

On the profit from the natural history point of view yielded by the two days' trip, I can best give a clear idea by naming all the plants and animals which were seen and *noted*.

Of plants we found : reindeer moss, lichen, moss horsetail, polypody, ferns, fir, spruce, larch, juniper, brome-grass, cock's-foot grass, rye-grass, couch-grass, quaking-grass, meadow-grass, fescue-grass, rye, oats, barley, spring-grass, grass-wrack, beach-grass, sedge, rush, orchis, may, Solomon's seal, asparagus, catchfly, evening-glory, stitchwort, sandwort, arenaria, pennywort, sea-holly, horse-radish, shepherd's purse, evening-violet, sea-call, sea-rocket, speedwell, foxglove, mullein, yellow rattle, cow-wheat, wood and sweet pea, yellow sweet pea, sea pea, bitter vetch, vetch, fodder-vetch, acacia, bladder-senna, vine, wild vine, ivy, clematis, privet, ash, maple, birch, hazel, willow, poplar, beech, oak, walnut, true chestnut, horse chestnut, elm, alder, cherry-tree, pear, apple, apple-rose, potentilla, marsh cinquefoil, ragged robin, bennet, strawberry, blackberry, raspberry, gooseberry, agrimony, black crowberry, heather, bell heather, yellow stonecrop, livelong, snake's head, forget-me-not, bugloss, neat's tongue, hound's tongue, gromwell, bird's-foot trefoil, lady's-finger, clover, snail-trefoil, devil's-bit, jasione, cornflower, knapweed, yarrow,

sneezewort, oxeye, yellow oxeye, daisy, dandelion, hawkweed, nipplewort, thistle, burdock, cockle, poppy, swallowwort, white dead-nettle, red dead-nettle, self-heal, ground-ivy, thyme, mallow, hollyhock, stork's bill, crane's-neck, chickweed, money-wort, goldylocks, bindweed, cleavers, hop, polygonum, water-plantain, buttercup, cow-bell, columbine, larkspur, iris, gilliflower, bryony, bilberry, nettle, lycium, potato, fucus vesiculosus, laminaria, fork-weed, red seaweed, green seaweed, puff-ball, star-flower, wood sorrel, mustard, charlock, dog's-tail grass, sorrel, dock, pansy, St. John's wort, wolf's milk, meadowsweet, blackthorn, mountain ash, sorbus A'ria, rest harrow, broom, loosestrife, thrift, campanula, elder, honeysuckle, fleabane, grey mugwort, sea mugwort, tanacetum, groundsel, goat's marjoram, hawkweed, and others. Altogether there are about 190 types. Among these there are naturally examples both of species and genera, indeed of higher unities, according as the pupils can distinguish—and the teacher has the information.

Of animals we saw the following: gammarus, crab, copper-worm, jelly-fish, sea porcupine, starfish, mussel, cockle, freshwater mussel, cod, plaice, frog-fish, migrating elvers, periwinkle, whelk-shells, salamander, green-mottled toad, wren, wagtail, goldfinch, swallow, wood-lark, crow, lark, goose, yellowhammer, glowworm, dragon-fly, and so on. In all there are about 30 animals.

In the geographical department we had occasion to observe the following: (1) the sky, its form, colours, the clouds, (2) the sea, with waves and currents, (3) shingle, gravel, and beach sand, (4) downs and their mode of formation, (5) clay slopes with springs, slides and cones, (6) erosion in a streamlet bed, (7) brook, with its outlet into the sea, (8) the old raised beach by the high road, etc.

The total yield of the excursion comes out perhaps most clearly in an ejaculation which escaped one of the boys. He said: "This is the best day I have ever spent." Grant that this is a momentary exaggeration; it cannot be doubted that he found the excursion highly profitable.

In the summer of 1907 I made a somewhat cheaper and more convenient excursion with some boys and girls direct to Gilleleje, and thence by rail to Gribsö, whence we walked to Hilleröd. "It was the best of all the trips we have had," the children often said. They certainly did not see all the geological phenomena and forms of vegetation mentioned above, but they saw the greater part of them.

Another district which also is good to visit with pupils, and which can be studied in a single day, is Tisvilde and Asserbo. From Copenhagen the children can take the train to Tisvildeleje, and then go to the ruin and back to the station; and from the ruin there is a fine circular tour through the old wood to the shore and thence across the heath through young plantations; there may also be time for a short visit to a moor. On this excursion the pupils can see (1) spruce forest, (2) beech forest, (3) larch forest, (4) birch forest, (5) the "Witch's Wood," or "Devil's Wood," just below Brantebjerg on the left; it has trees strongly bent by the wind, (6) fir plantations, (7) down vegetation, (8) raised beach and sea, (9) heather, (10) arable land, (11) moors, (12) the sky, (13) glacial formations, etc. In the summer holidays of 1909 I noted the names of about 190 plant types in this district, and also a large number of animals which could be observed nearly every day, including the following: ringdove, magpie, jackdaw,

swallow, sparrow, crow, gull, starling, lark, woodlark, yellowhammer, snake, viper (seen twice in a month), many kinds of butterflies, beetles, dragonfly, grasshopper, wasp, ants, bees, humble-bees, gadfly (the cow's), sea-snail, mussel, crab, jelly-fish, sea-nettle, cockle, sand-gaper, gnat, cranefly, spider, earthworm, tubicole, etc.

Many readers may possibly find it a little strange that I should enumerate all these names of common animals. But I do so deliberately in order to bring to notice the duty of not neglecting to give children the opportunity of seeing everyday things such as a spider in its web or ants bustling around their nests. *Children have to learn to study what is in front of them. It is not observation of nature to let the eyes rove round a landscape and catch a glimpse of a crow.*

Besides the localities named, there are, of course, many others suitable for school excursions from Copenhagen, and corresponding districts may be found around nearly all our towns.

But even in the nearest vicinity of Copenhagen there are many different vegetations, with a fairly rich animal life, to which one may take one's pupils. In the first place there are the parks, as Søndermarken, Frederiksberg Park, and Faelled Park. Then there is Charlottenlund, the Zoological Garden, and the somewhat more distant woods.

In Søndermarken a class which was studying the shooting of the leaf saw in the course of a good hour the following plants: briar, sycamore, maple, beech, oak, elm, horse-chestnut, elder, hornbeam, poplar, cherry-tree, caprifolium, privet, mountain ash, gooseberry bush, raspberry bush, *gagea lutea*, stitchwort, daisy, coltsfoot, dandelion, nipplewort, onion, violet, anemone, pilewort, ranunculus, gout-weed, *anthriscus silvestris*, nettle, bennet,

plantain, duck-weed, dock, cleavers, soft-grass, speedwell, ground-ivy, together with the following animals: chaffinch, starling, blackbird, newly-hatched young blackbirds, sparrow, tree-sparrow, weevil, wasp, scolopendra, the true millipede (Julus and Glomeris), woodlouse, earthworm, snail, wood-snail, field-snail, ground-beetle. In the case of the plants observations were made specially with regard to their defence against cold in the winter and against rain and evaporation after the shooting of the leaf. Each of the animals was cursorily examined for the purpose of noting particular characteristics, such as the breathing-holes of the snail or the difference between the millipede and the woodlouse, and so forth.

Charlottenlund is best visited in the autumn; one can e.g., show the pupils the effects of the conflict between beech and oak, which is especially noticeable in the northern part of the park. From Charlottenlund one can make a little trip down to Öresund by the "fly-paper." Although the long enumeration of names becomes wearisome, I will here mention the animals which a class saw in October, 1909. They were the following: gammarus, mussel, sand-gaper, cockle, *telina baltica*, sea-nettle, sea-snail, woodlouse, spider, harvestman, young tants, grasshopper, caddice-fly, crane-fly, scarab, ground-beetle, dragon-fly, snail, slug, wood-snail, looper-larva, frog, toad, wagtail, titmouse, chaffinch, crow, sparrow, and gull; in addition, they saw twenty common fungi, some seaweed and about thirty flowering plants.

Klampenborg is especially suitable for an excursion in spring-time for the purpose of viewing the spring flora of the undergrowth. But at the same time a large number of vegetation-types may be observed, viz.: (1) forest-enclosures, where larger animals cannot come, (2) beech-wood, where the animals range freely in large

numbers, (3) grass-land, (4) woodland outside our Zoological Garden, with undergrowth and possibly spring flora, (5) free-growing oaks, beeches, birches, blackthorns, etc.; trees gnawed by deer, (6) pond with marsh vegetation, (7) conifer forest, etc. In my book "The World's Development,"* I have drawn attention to a number of instructive observations which can be made in these vegetations, and this may possibly serve as guidance for teachers who propose making excursions to them.

Another interesting locality in the neighbourhood of Copenhagen is the Damhus Lake. Unfortunately it is now often almost dry; but there is always water in the canals, and many plants and animals may be seen on a visit to it. In June, 1908, my pupils saw the following: nightingale, yellowhammer, flycatcher, chaffinch, sparrow, swan, swallow, coot, snail, wood-snail, moor-snail, planorbis, horse-leech, earthworm, stickleback, water-beetle, fresh-water gammarus, fresh-water woodlouse, boat-fly, whirligig, water-devil, water-mite, gnat-larvæ, dragon-fly nymphs, frog, toad, etc., besides thirty-one plant-types.

Lastly, in close neighbourhood to Copenhagen, out at Flaskekroen, there is a meadow, shore-meadow, and a delta. Unfortunately one cannot walk about here, as the municipality sells the grazing, but possibly with the assistance of the right authorities access might be obtained for schools to a limited area. On an outing in July, 1909, partly on the way there, partly in the meadow and shore-meadow and the enclosed delta, a class saw among other things the following animals: lapwing, gull, wild duck, sandpiper, swift, lark, thrush, chaffinch, kestrel, starling, *pieris*, owl, weevil, humble-bee, honey-bee,

* Second edition, 1927.

wasp, larvæ of willow-borer in a willow, tadpoles, frogs, etc.; in addition we saw about sixty types of plants.

On a quite short visit to the new railway embankment outside Frederiksberg in August, 1909, a class found about 70 types of plants and 22 different animals.

As every teacher of natural history can see, the profit derived from these and other similar excursions is very considerable; and when the results of many excursions are put together they become extremely valuable in relation to the requirements of instruction and examinations in the intermediate and "real" schools. A large number of plants and animals are observed again and again, so that the pupils learn to know them in the open; and at the same time they see some of rare occurrence and escape the temptation to think that the few forms they know are all that exist.

The particular types, however, are the least important matter; they are quickly forgotten, and the knowledge of them has little value except for examinations. *The main point is that the children see the great forms of collective life at different seasons of the year and the peculiar animal-world of each;* and although the school-age lasts only four to five years a large number of vegetation-types in different biological situations can easily be made the object of direct study. This applies *inter alia* to (1) *the coniferous forest in the autumn with fungusflora*, (2) *the deciduous forest* (a) *in winter garb*, (b) *with spring flora*, (c) *in the shooting of the leaf*, (d) *in autumn colours and the fall of the leaf*, (3) *meadow and shore-meadow*, (4) *the fields*, (5) *the moor*, (6) *pond and stream*, (7) *heath*, (8) *the down*, (9) *shore vegetation*, (10) *the sea, etc.*

One might conjecture that when the teacher stresses vegetation-forms and the biological peculiarities the pupils are led to neglect individual species and genera.

I had expected that myself; but experience has shown that the case is far otherwise. *The pupils are, on the contrary, now more interested in species than my pupils ever were when I myself laid weight on the knowledge of species and brought many plants to the lessons.* This may seem strange, but is, nevertheless, easily intelligible; for when the pupils get out into the open so often they nearly all pick and press plants which they fix in their natural history essay-books with strips of stamp-edging. Therefore without doubt they *know* more plants than my pupils formerly knew, even if they possibly *know fewer names* of plants; and with animals, though for slightly different reasons, the case is much the same.

The excursions, of course, do not take place casually, but are arranged systematically in close connection with the school's plan of instruction in natural history. This plan runs as follows: *In Class I, the manifestations of plant-life, types of plants and animals from moor and forest, studied by means of written exercises on the basis of direct observation of animals and plants, by drawing animals and plants, and by the use of my botany and zoology text-book for intermediate schools; in Class II, new types of plant, together with fish, amphibia, reptiles, and a selection of articulata; in Class III, new plant-types, the lower animals of the sea, and birds; in Class IV, difficult plant-types, plant-communities, flowerless plants, Danish trees, mammals, hygiene, parasites, and a general survey of the system.*

In teaching zoology, however, to Class I, I took first the fresh-water animal forms, and also mammals, before beginning on forest animals, *because nearly all the fresh-water animals can be shown alive either in an aquarium or in Damhus Lake*, excepting particular birds and mammals.

Schools situated out in the country can, of course,

carry out a real study of nature in much better ways. What can be accomplished if the teacher will give himself the trouble, I learnt from a visit to the Frederiksberg Teachers' Association holiday-colony at Kongsöre. With a number of boys I went for an hour's walk along the beach and in the wood, and they found about 95 plant-types and 18 different animals. Close consideration should, therefore, be given to the scheme put forward by individual teachers, which amounts to keeping "school in the greenwood." With an intelligent plan of instruction, there can be taught an extraordinary quantity of natural history, and at the same time a little geography, astronomy, and physics, all directly observed. True, one cannot move out whole classes; but one can take from several classes a number of children, about on a level with each other and specially needing country life, and give them a month's open-air schooling additional to the six holiday weeks which precede or follow the month. No doubt the result will at first be a somewhat motley assemblage, but that seems to me a trifle in comparison with the beneficial effects of a long sojourn in the open. Of course all the phenomena accessible to direct observation should be utilized preferentially, while the other subjects might be postponed to the school-time in town.

In addition to the great importance which such a residence in the country would have from the point of view of health and knowledge of nature, there are other ways in which children may draw great profit from outdoor life. Even in the shorter excursions, but particularly during a longer stay in the country, each child walks about quite quietly and privately, gathering a host of impressions. He keeps them to himself, but all the same they are not useless lumber. Some fine day they reveal

themselves in the adult's emotional life, in his feeling of being at home with nature ; possibly even in childhood they have shown the way to something on which he can fall back when various illusions have vanished.

Besides taking part in the excursions, the pupils have at the same time written essays. To begin with, they wrote about cut plants ; later, I got them to take note-books with them on the excursions so that they might record the most important observations. Then in lesson-time they wrote a report in an essay-book. When all the observed natural objects had thus been described, the pupils began to describe types of woodland invertebrates. For the preservation of the animals in a condition of easy accessibility to investigation I had some small boxes made with glass lids and glass bottoms, 16 cm. long and broad and 8 cm. deep. On the glass bottoms corks are glued, 1 cm. in diameter and about 1 cm. high ; in these are set pins bearing the insects. These are thus observable from all sides, especially from back and abdomen ; this has the result that each pupil has a box to himself with a few animal forms ; and these can be chosen on the principle of setting side by side animals which to a casual glance look alike, but are really very different, e.g., fly and humble-bee, cockroach and ground-beetle, sesia and wasp, and so forth. In this way the pupil's attentiveness is stimulated, as he does not know beforehand that the box contains only beetles or flies.

By thus dispersing the lower animal forms of the collection, I have been able to limit the oral instruction very considerably and also the desk-conversations. Each pupil has an exercise book in which he describes the animals, which, for the most part, he has seen in the open and helped to collect ; in this book he gums his

drawings and dried plants. Now and then, say once a fortnight, I correct the essays.

Having now given this short account of the course of instruction, I will quote a few samples of essays. Those of boys and girls are marked B. and G. respectively. With one exception, the essays quoted are all by different pupils.

I.—A VISIT TO DAMHUS LAKE

I have made many excursions to Damhus Lake, but none have been so interesting as the one I made in the autumn of 1907. It was in August, so the autumn had not yet properly begun. I also studied the road by which we went there. I walked close by the side of the ditch and looked to see what plants grew there. The plants that there was most of were stinging-nettles, but there were also other plants that there were many of. A little way out on the road is a large hedge which was quite full of haws. I picked a few and examined them closely. Further on near Damhus Lake is a large field with red beet. I pulled one up and made this note on it : The beet is a taproot very like the carrot, but much larger. The colour is reddish at the middle and greenish at the top. I cut off a little piece and tasted it. The taste is like that of the carrot, but a little more sweetish. Just opposite the field is another field with roses. I got a rose from a man who was walking there. It was red and not properly out. The rose-leaves were red at the top and white right below. They end in a calyx, which consists of several green leaves that are full of hair. When I had closely examined the rose I went further on to Damhus Lake. When I got near I was glad to see that there was no water in it, because now I

could study the lake-bed closely and also the plants which grow there. Inside at the edge grew a whole quantity of polygonum with red flowers. Further out nothing grew. There the earth had opened in great cracks which were full of shells. The earth was very moist, and in some places moss was growing. When I had studied the lake-bed I walked up the road. There is a whole row of willow-trees. I wanted to get myself a switch, but could hardly get one cut off, as they are so tough. The bark of a willow-branch is green, whereas on other trees it is black. The boughs are also more equal than on other trees. Under one of these willow-trees I found a large larva* of a willow-borer. It is very handsome and large. It is red on the upper part and yellow in the middle. It is divided into rings, and on all the rings, except the three first, there are breathing-holes at the side. On the three first rings are placed the legs. It has six legs, two on each ring. Beneath are the suckers. It has ten suckers, two on each ring. The whole larva is soft except the first ring after the head ; this is a hard shield with a remarkable design. The head is very little and black. It is naked except for the head, which shows some small hairs, but there are not many. When I had put the larva in my botany case I walked further out to the stream. A little way along the road I found a dead shrew-mouse. I picked it up and put it away ; but when I looked at it after reaching home it had begun to putrefy. I laid it down in the garden, and when I looked at it a month later there were some white worms eating it. They certainly came of themselves, for the box in which it lay was closed.† I walked further on to the

* In the essay is a water-colour drawing of the larva.

† An interesting example of an autogenesis-theory based on superficial observation and thought.

Damhus Lake. Soon after I reached it and began to fish. The first thing I caught was a scorpion-fly. I was surprised at its being so thin. There is no room at all for anything inside it. In front on the head between the foremost legs is a curious point, and at the side of this are the eyes. It has six legs and breathes through a long breathing-tube, which it sticks up above the water. How does it come that the breathing-tube divides into two parts when it stands out of the water ? I put it away and fished on. A little afterwards I caught a water-beetle and set about examining it closely. The water-beetle is a large animal that lives in the water, but often flies on land. It has six legs, and on the foremost there is a round surface. On the back are the wing-cases, which are like a hard shell. The water-beetle has six legs, which are divided into three segments. On the extreme segment is a quantity of small hairs. It has two large eyes and two long feelers. The next thing I caught was a boat-fly. It also is a water animal that often flies on land like the water-beetle. It is not so large as the water-beetle, and it has not a hard shell on its back like the water-beetle. It has six legs, but no feelers. The water-beetle has two large eyes which reach round from the mouth to the back of the neck. It is flat underneath and sharp on the back. When it swims it strikes in the water with its hindmost legs. These, like the water-beetle's, are full of small hairs. Suddenly as I stand with the boat-fly in my hand it flies from me down into the water. A little afterwards I got tired of fishing and set out on the way home. I walked across the little island in Damhus Lake. It was overgrown with tall rushes that were taller than me. In among them were jumping a quantity of frogs and toads ; there was also a mass of empty snail-shells. Then I went up on to

the road after examining the island very thoroughly. On the road there was a quantity of animals flying around me. I thought they were gnats, but when I got a proper view of them I saw that they were pond-flies. Now I had to hurry home, for it was getting late. I therefore walked faster homeward. A little later I came to some planking which was full of pupæ. I took a whole lot of them and put them away. They are white with black spots on them. I also took a whole lot of red pupæ that I don't know the name of. A little further along the road there is quite a lot of manure-heaps. A quantity of scarabs were flying about. I noticed that scarabs fly quite well. In a large heap of manure I saw some scarabs swarming over each other like ants in an ant-hill. I went quickly towards them ; and the moment I reached them they all lay together quite still as if they were dead. I took a scarab and investigated it. It is black on the back and greenish-blue underneath. It has six legs, which look as if they were very powerful. Above it are the wing-cases. They are hard and grooved. The head is not so large, but has much hair. A little further I found a robber-beetle. It can run very fast, and when it runs it sticks its hind part straight up in the air. Its wing-cases are very small ; beneath them are the true wings folded many times. When I came home I was very tired and hungry. As soon as I got to bed I slept till next day.

Class I, Intermediate (age 11). B.

II.—THE CLASS AQUARIUM

The class aquarium is a large square glass $\frac{1}{2}$ ell broad and $\frac{3}{4}$ ell long ; and the glass is thick and strong. The aquarium is half-full of water, and the water in it is a

little yellow. In the water are a number of water-plants which consist of a long and thin stalk. The stalk is full of small and somewhat oblong leaves. In our aquarium there are three sorts of water-plants which are named as follows : water-milfoil, water-thyme, and seaweeds. The water-plants stand very closely beside each other in the aquarium. On the bottom of the aquarium there lies sand. There also lie there a pair of large sea-shells, and when I tried to lift them they were very heavy. In the water there live planorbis and moss-snail.* The shell of the planorbis is quite black and in some places a little white. It comes to the surface by the help of a suction-disc, with which it goes on sucking itself fast till it comes to the surface to take breath, as it breathes with lungs. It often lies still at the bottom of the aquarium. It lives in fresh water and feeds on water-plants. There are also many sticklebacks in the aquarium. They are small and slightly oblong fish and they live both in fresh water and in the sea. They swim by bending the tail to and fro as well as by moving their fins. One can see them lying quite still in the water moving their mouth and gills [i.e., gill-lids]. They do it because they are drawing breath. They breathe with gills. Their eyes are large and black. The body is oblong. It is slightly pointed at the tail end and becomes broader higher up, and then the head again runs out to a point. Sticklebacks swim for the most part in among the water-plants. On the back they are light-brown and there lie, as it were, a number of scales close by the side of each other and in rows. On the belly they are white. The males have some pointed spikes on their back which they use to defend themselves. In the summer there were many small animals and fish in the

* *Limnæa.*

aquarium. Of fish there were pikes, perches, and sticklebacks. Of small animals there were postman,* water-beetle, water-mite, water-spider, and various sorts of snails. There were also many leeches.

Class I, Intermediate (age 11). B.

III.—SØNDERMARKEN

The soil in Søndermarken is not very rich in plants in the places where trees grow. On the other hand, it is covered with a thick layer of leaves and branches and twigs, and besides that there are, in particular places, small trees which are not even six inches high. In many places, especially under the trees, one finds the fruits and seeds of the various trees. The seeds of the horse-chestnut are round lumps which have outside a hard, brown, thick shell, and inside is a whitish-yellow mass. In this mass, if one cuts it across, can be seen the kernel, which is very large. In one place on the shell there is a very large whitish-grey spot. That is where it is fixed to the thick, green shells which enclose them in the spring. Besides, one finds beech-nuts, which are the fruits of the beech. The outside of the beech-nuts is a black shell, covered with prickles. Inside the shell is the kernel. The fruits of the oak, the acorn, also called pig-nuts, are contained in a little shell. These nuts are also found in the forest undergrowth. One sees nothing of the fruits of the elm ; they fall off in the spring. When one scrapes away the topmost leaf-layer, one sees that some of the leaves are drawn down into the earth so that only the uppermost can be seen. It is the earthworms that do this, for they live on decayed parts of plants. In some places, on digging into the earth, one can find

* *Hydracna.*

the bulbs and roots of various plants, for example, pilewort.

Where there are no trees it looks quite different. There all the earth is overgrown with various kinds of grass and dandelion, mayweed [i.e., daisy], buttercups, forget-me-nots, and others. Some way out in front of the trees there grow small trees of the same kind that grow on the forest edge. The dandelion has a taproot. Its leaves are deeply incised and are firmly fixed like those of the cowslip, but lie closer to the earth. The stem is hollow and can be very readily snapped. When one breaks the stem there comes a milk-white bitter liquid. The flower is an involucre, and consists of a number of petals. It has a number of stamens, which contain much yellow dust. When the flowers have fallen there come many seeds, which have some large light things on them so that the wind can blow them a long way off. They bloom only in the spring. The dandelion is a weed. The chestnut leaves are placed on a large stalk, which is light-yellow. The leaves are quite narrow at the lowest part and so get broader, and right at the top they are shaped like a point. They are very indented and pinnate [!]. The commonest trees in Søndermarken are beech, oak and elm. The bark of the beech is smooth. On the trees which stand inside the wood the trunk is bare over a large piece below ; but on the edge the crown of leaves reaches about down to the ground. This is because the leaves are so placed that the sun cannot shine except upon the uppermost leaves. The leaves of the beech are pinnate and the trunk is tall and straight. The oak is a complete contrast to the beech. The trunk is low and twisted. The bark is rugged and the leaves are indented.

Class I, Intermediate (age 11). B.

IV.—CHARLOTTENLUND IN NOVEMBER

When we came into the wood we first looked at the soil. It was greyish, and when we dug into it we saw a whole mass of wood-splinters mixed with the earth. There were also earthworms in it. Further inside the wood the soil was darker, in some places it was like mould. We also saw molehills. It was coal-black earth that lay in a heap over the hole. The passage was almost quite round and curved down deep into the earth. All the floor of the wood was covered with various kinds of leaves, for example, oak and beech leaves ; there were masses of them. A beech-leaf is pinnate with a large rib going the length of the leaf, and from the main rib side-ribs go out. A beech-leaf has not an indented edge, it is on the contrary very even. The one side is dark, the other lighter. On the dark side the sun has shone most, on the light side least. A withered oak-leaf is very dry. That is because the sap has gone out of the leaf. It is also pinnate like the beech-leaf. There goes a rib through the length of the leaf, and from this the side-ribs go out, but there are not so many side-ribs as in a beech-leaf. An oak-leaf is very indented, so that it looks like tongues on the side of the leaf. There were many beech and oak trees out in the wood. There were many more beech-trees than oak-trees. The beech has a tall straight trunk. There are only boughs, twigs and leaves right up at the top. The leaves are placed very close together, so that they form a large surface on every branch. There were therefore as good as no branches on the trunk, because they could not get any sun or light, and therefore they fall off. The oak has a very crooked trunk. The oak has, however, some branches

[i.e., twigs] on the trunk because the leaves are not placed so close together as on the beech ; therefore the branches can get sun and light. There where oak and beech grow together the oaks die out, they cannot hold their own with the beeches because the beeches grow up quicker than the oaks, and because with their dense masses of leaves they take all the light away from the oaks. On some of the oaks' trunks there is lichen, but it is found only on the one side. Why ?

Class I, Intermediate (age 11). B.

V.—KLAMPENBORG PARK IN MAY

On the first of May we were in the beech-wood [at Fortunen]. The soil of the wood is light-brown with all the withered leaves, and there was a thick layer of leaves. At the beginning we only saw some flowers and not so very many trees. Hardly any trees were out, but the buds were large and thick, with scales on them, and they were ready to burst. Inside the wood there were some huge hills and on the side of them thickets of thorn and other bushes, and it was almost impossible to get through them. As we gradually came further into the wood there began to be more trees, bushes and flowers. The first flowers I saw were anemones, which are white with light-red stripes, but there are also yellow anemones. Anemones have a very thick underground stem, which one would think was the root, and from the underground root there go out side-roots which are white and thin. In some places in the wood there was a whole white carpet of anemones, and that looked very pretty. There are also goldstars* whose flower is very like the pilewort's flower, which is yellow. The goldstar consists of a

* *Gagea lutea.*

stalk which grows up from a bulb that lies deep down in the earth. From the stalk there come again five to six small stalks and on these are the flowers, which have three petals and three sepals, and they are yellow. On the stalk there is a long sharp leaf. The pilewort has a large tassel of fine small roots, and from these there come up a quantity of stalks in all directions out of the ground. On the stalks there are green leaves like hearts and then the yellow flower. It consists of eight petals and stamens. There are also violet, wood-sorrel, and a quantity of other flowers. There grew mostly beech-trees in the wood, but there were single fir-trees and one or two other trees. There also grew wild gooseberries in there.

Class II, Intermediate (age 12). B.

VI.—THE SOUTH EUROPEAN LIZARD

The south European lizard is like our own lizard but it is much bigger. The colour is on the back greyish-blue, and on the belly it is more bluish. The head looked at from in front is square but it gets more pointed towards the mouth. The scales over the head are very large compared with the others and especially those on the top of the head. On the head are found two eyes, placed one on each side of the head. The eyelids consist of a thin skin, the lowest is largest. Out on the points of the head are two small holes, they are the nostrils. Behind the head are the ears, one on each side. The ear has no gristle, but the drum is quite exposed. At the lowest part of the head is the mouth ; it is very broad, it reaches to right under the eyes. Inside the mouth it has small teeth. Up in the palate there are two clefts and these are the inner nostrils. The tongue is

long and split. It lives on small animals, snails and worms. There where the neck begins the head goes steeply down and the back of the head is large. The neck is short and round, and above and on the sides of it are a number of small scales, but underneath they are larger. The body is long and round, and on the sides and back are placed small scales, but on the belly they are much larger, particularly they are very broad. Between the hind legs is the anus. The front legs are divided into two segments, upper arm and lower arm, between them is the elbow-joint and at the end of the lower arm is the wrist. Here is formed a flat plate like a hand. Hence go out five toes, which are fairly long and at the end of each is a curved nail. The hind legs are longer and thicker than the front legs and are like them in other respects, but the toes, especially the third and fourth, are much longer than the front toes, and between the fourth and fifth toe there is a big interval. Also on the legs there are scales, but they are largest on the side that turns down towards the ground. Between the two hind legs begins the tail ; here it is thickest and becomes thinner and thinner outwards. The tail is very long, three times as long as the body, and it is round. There are scales here, as it were in rings, but they are very small. When the lizard walks it drags its body and tail along the earth, but bends them at the same time to the sides, and so it is worn more there and therefore the scales are larger. The lizard lives in the undergrowth and the colour is very like that of the earth. If one takes a living lizard in one's hand one notices that it is cold.

Class I, Intermediate (age 11). B.

VII.—A WOODLAND OUTING TO BAGSVAER

There were many old coniferous woods out in the wood. The trees were very high spruce and fir trees. In such woods the trees stand very close together. Their trunks are straight, and there is nothing else but small straight branches. On the lowest part of the trunks the branches are dead and dry because they do not get enough light; there are no needles on these branches, but up in the top the branches are covered with the small, evergreen needles. Below the soil is covered with a thick layer of fallen needles and cones of both fir and spruce. These trees are alike summer and winter. We saw more of the beech woods than the coniferous woods. The beech wood has begun to fade and to clothe itself in autumn dress. Some of the trees were brown, others very dark green; but there are almost no leaves on the trees. When we stood on the one side of the Fure lake we saw that the wood on the other side had a brownish tinge and the brown trunks and boughs shone far and wide all around. The soil was covered with a very thick brown layer, this is the fallen leaves which have decayed. They are soft to walk on. When one scrapes a little of the layer to one side with one's foot, one sees that the further down one gets the darker are the decayed leaves, for the lowest have been lying longest. Round about in the wood there were growing many fungi. They are flowerless plants that live on the decayed leaves in the undergrowth, they live mostly in the coniferous woods. There are a number of different ones; some are eatable, but most are poisonous. Some of the worst are the ones I am going to write about and the toadstool. The verdigris mushroom is dark green. Down among

the needles it has a mesh-work, like a fibrous root, which answers to root, stem, and leaves in flowering plants. Above the earth is the hat and the stick; one can easily remember it, for it is like a stick with a hat on. The stick is hollow, and it is thickest there where the mesh-work is fastened to it. Outside is a thin green rind; when one pulls it off a yellow woody stuff comes to sight which is very brittle. The hat is round, flat, and not specially thick. On the upper side it is dark-green, smooth and flat. The edge bends down a little. The green as on the stick is a thin rind; under this there is a not so thick layer of white flesh. Under this there are numberless little brown plates. They are as thin as paper but not transparent; they are very brittle. The flesh is also very brittle. In the middle there are no plates, for there the stick is attached. The green rind is like paper. Between the small plates is a quantity of little seeds, which are called spores. They fall out and blow around. They are the funguses' means of increase.

Class II, Intermediate (age 12). G.

VIII.—PLAICE OR FLOUNDER*

One day my mother had some plaice and I was allowed to borrow one. It lives in salt water on the sea-bed where it digs itself down into the sand or also lies there with the white side under so that larger fish shall not see it and eat it.

It has a very sharp and compressed body sharp on the back and belly and the greater part of the circumference is edged by the dorsal fin and the anal fin which about

* This essay is no doubt defective in point of form, but the matter is excellent.

cover the whole. It is not at all like other fish in that the back and belly or under-side are so sharp and the two sides are very flat but it is right large. One would think that when the plaice lay down the upper the brown-grey side was the back and the under, the white side, the belly but [that this is not so] can be shown by the fact that on both the two sides there goes the side-line and on the lowest sharp side is placed the anus and further on the abdominal fin, this is a sign that the upper part is the back.

Its head is much askew. Its mouth turns a little upward towards the back, but it is not really big, but it can be widened a little, and when it is quite widened it is almost circle-round. The outermost part of the mouth is very hard, [it] seems like horn-jaws, does it bite with them? The head is three-cornered, but not really big. One of its sides is grey-brown and the other white. [On] the grey-brown part of the head is a pair of very big eyes which are askew and stand a long way out of the eye-holes. In other fish on the contrary there is an eye on each side of the head. With the finger one can push the big eyes right into the head. They are very smooth to the feel [and there is a] blue pupil with a yellow border round it. There is a hard bone or horn plate on the upper part of the head which protects it, the lower part of the head is very soft. I can see no nostrils or ears. On the one side of the head obliquely in front of the eyes is the great gill-lid, on the other side it is just underneath. If one opens the gill-lids one can see inside three arched light-red gill-slits [i.e., gill-arches] which are very slimy. Above the gill-lids are very hard, it is a bone plate which is inside the skin and it is also as it were divided into two bone plates.

The form of the plaice is oval but pointed at the ends.

The one end is the head and the other the tail-fin which is very broad [i.e., high]. On the grey-brown side there are some red-brown spots, these consist of rings which are like a star in that in the middle there is a ring and round that again several small rings. The whole skin which can be flayed off consists of a quantity of small, very small rings over the whole.

About along the middle on both sides goes the side-line which above at the gill-lid makes a bend. On the white side there are no spots, it is chalk-white and the side-line is very indistinct on that side. It is all over very greasy and slimy. The softest and best meat is on the white side and the skin there is thinner than on the grey-brown side.

Over the back and right from the head almost to the tail [i.e., the tail-fin] goes the dorsal fin which is an inch broad. On the under-side is an anal fin which is almost equally as large as the dorsal fin. The anus lies very far up. On each side of the body are placed the pectoral fins. The fins consist of some stiff quills and between them is a thin skin. On the fins, the dorsal and anal fins, there are some big brown spots. In the tail it is hard to the feel. If one holds the plaice up to the light one can see its inwards.

Its young are like quite small other fish. It lives on small animals.

Class III, Intermediate (age 13). B.

IX.—THE DRAGON-FLY

In the middle of the summer one may see a large number of dragon-flies in the woodland meadows and generally speaking in places where there is strong sunshine and a lake or a moor in the neighbourhood. For

in such places there are many small insects and these are what the dragon-fly lives on. Perhaps too it is because it lays its eggs in the water and the larvæ and nymphs live in the water. The larvæ are segmented. They are animals of prey. On the under-side of the head they have a pair of pincers on a shaft. With this they take their prey. At the point of the abdomen there are three blades. With these they take up oxygen from the water. When the larva gets older it begins to change its skin. After changing its skin the larva has a new appearance. It begins to get wings. The last skin-change takes place on a rush up in the air. After that it is a full-grown dragon-fly. In most dragon-flies the body is very long and thin. The head is large. It is placed on a quite thin neck.

The two compound eyes fill most of the surface of the head. When it hunts these big eyes are useful when it has to follow its prey in the air and at the same time beware of birds. It has enormously strong mouth-parts. The edges of the jaws go the length of the head. The legs are short and weak. They are only good for holding on tight. This also fits in well with its being an air-animal.

Its wings are long and pointed. From them alone one can readily see that it must be a good flier. Its wing-ribs form a very fine network. The ribs are most marked at the forward edge as in the sesia. At about the point on the forward edge of each wing there is a mesh in the wing-net which is filled with a hard, opaque substance, most likely chitin. The dragon-fly's wings are very handsome. They have fine colours with metallic lustre which are different according as how one looks at the wings. They remind one of the colours sometimes seen patch-wise on the ice. Since now the conditions

under which one sees the colours of the ice and of the wings are much alike, possibly these colours arise in the same way, namely, by the sunshine first going through the uppermost layer of skin. Some of it is thrown back and some goes through and is refracted. On the lowest layer the rays are refracted again and thrown out towards the uppermost layer and pass out into the air as several different colours. But some dragon-flies also have colouring-matter in their wings. There are some kinds, those with the slender, thin, metallically lustrous bodies, which also have deep colours on their wings. Some have only a large, dark spot on the middle of the wing, others have this colour over the whole of the wing. In most the colour is deep blue ; but there are many with shades towards green, and I have seen some that were quite red-brown. They live over streams, and there is generally a rich insect-life because of the meadows around the stream. These handsome dark colours make them difficult to distinguish above the dark stream-water. They nearly always fly across the stream from bank to bank. Their flight is much more uncertain than that of most other dragon-flies. They are common in Jutland. Sometimes one sees dragon-flies flying together two and two. The one then holds the other, the female, round the neck by a claw which it has at the point of the abdomen. They fly out over the water, and the female then lays her eggs in a rope on water-plants.

Class IV, Intermediate (age 14). B.

NATURAL HISTORY OBSERVATIONS FROM THE SUMMER HOLIDAYS*

1.—*Habit.*

In the country they had a horse which was accustomed to go to the kitchen door to get a piece of sugar or bread, when it had been out driving. Now it happened one day, when it came home, that the door was standing open and there was no one at home. The man was standing doing something with the carriage in the belief that there was someone to give the horse bread ; but by your leave. The nag put his front legs into the kitchen and was about to go right in when the man ran up, seized the reins, and pulled him out.

2.—*What fear can do.*

A pair of pigeons had a box in which they hatched their eggs. The box was placed right up under the eaves. One night the rats came and destroyed the eggs. The old pigeons were seized with fright and flew up on the roof. In the morning we discovered the catastrophe and therefore fixed up another box on the opposite wing, but they did not find it. Some time after they were sitting again. They had built a nest and laid eggs above the box under the eaves. They never went into the box the rats had been in.

3.—*The fear of animals for things coming from behind.*

One day we had to cart manure out on the field. We drove the one way up and the other down. At the end

* Written by a boy of 14 in the " United Church Schools."

of the road, or rather field, lay the railway. When we now drove up the field, so that the horses had their heads turned towards the railway, the train might go right past them without their noticing it. But when we drove back so that the horses' heads were turned away from the railway we could hardly hold them when the train came, for they pricked up their ears and out of fright were ready to run away with cart and all.

4.—*Horses' comradeship.*

The same two horses were very good friends ; they could never do without each other. If we had to use one of them, the other was quite like a mad thing. If it was in the field it ran round its tether neighing till at last it pulled the post up. As soon as that was done, it ran home. If it was standing in the stall while the other was out it neighed and kicked so that one could not come near it.

5.—*The language of horses.*

When one horse had been out driving and came home, the other heard it from inside the stable. It began to neigh like anything. The one standing in the yard listened and then began to neigh. They now stood a little while neighing in this manner. Then the one in the stable began to kick and scrape the earth. For answer the other did precisely the same, but when it then went into the stable there was neither of them that said anything.

6.—*Terror of the poultry.*

Out in the field there were hens, chickens, ducks, ducklings and turkeys with their offspring. All at once there was a frightful uproar. They all fluttered away

to seek shelter. And a moment after the field was empty and all was still. The man and I were lying down at the watering-place. We jumped up on this strange performance and so discovered Reynard slinking away in the corn. No poultry came into the field again that day.

7.—*Proof that hens know they are going to have chickens.*

A hen had sat on eleven eggs. But another hen, about to lay eggs, had driven it from the nest, so that the eggs had become cold. The sitting hen went, however, to the nest. But when the day came when it should have had chickens, the eggs were all rotten. The hen went into the yard, but every day it looked everywhere for the chickens, and if it found a grain of corn it called them.

8.—*The lamb's knowledge of its mother.*

There were two ewes, one white and one black. The white one had a lamb. They all three stood in the field. The old ones were tethered, but the lamb was loose. One day we wanted to have the lamb at home, but it would not let itself be caught. We then took the black ewe home, but the lamb did not come for that. We then tied the black ewe up again and took the white one home, and now the lamb came with us. Once it had come home, it was an easy matter to catch it.

9.—*The puppy's memory.*

A dog was to have pups. It had three, but only the one was allowed to live. It was born in the barn, and it stayed there till it got big enough to walk by itself. Meanwhile it got older, and a woman had it. A fortnight after it had gone away the woman came and visited us.

She had the puppy with her. As soon as it was come it ran into the barn and lay down to sleep. There it stayed until the woman had to go back.

10.—*The sheep's playfulness.*

One of the sheep had got lost. We tried to catch it, but we could not. When we had run after it for a long time, it fell; that is to say, it looked as if it fell. We thought it had broken a leg, but as soon as we let go of it, it jumped up and ran away as hard as it could, and we had a job to catch it again.

11.—*How the cat goes hunting.*

One day a great flock of sparrows came down in our field. Immediately the cat came prowling round them a good way off. It went into the corn and came gradually nearer and nearer to them, creeping quite slowly and softly, until at last it was so near that it could pounce on them. Then it lay down, stretched its front legs forward and drew its hind legs right up under it. Then it gave a leap forward; but it did not catch any of the sparrows. It sat for a while composing itself, but then it went stealthily into the corn again.

12.—*The language of fowls.*

I will not here describe a conversation, as I have never noticed one, but the sounds which the cock and hen give out in particular circumstances. Now and then the cock crows. If the cock is with a number of fowls and one goes past and shoos at them, he raises himself and stretches his neck up in the air and makes a particular sound, on which they all flee. When the cock

finds a grain of corn, he again gives out a sound, and all the fowls gather round him to get it. Again he gives out another sound when he is out to fight with another cock. The hen gives out a particular sound when she has laid or is going to lay eggs, when she calls her chickens, or when she finds a grain of corn.

(Age 14). B.

First and foremost, of course, essay-writing gives increased practice in the art of giving a written account of what has been observed. It thus supplements the writing-exercises and the instruction in Danish composition. In the Intermediate School classes were allowed in the calligraphy hours to copy natural history essays from their rough drafts into their natural history essay-books.

It is of more value that the natural history essay engages the pupils' interest in a high degree, so that they not only work at school with satisfactory keenness but also describe (and draw) plants and animals, quite voluntarily, at home. These home essays are sometimes four, six, or even eight folio pages in extent, accompanied by drawings, so that the great interest shown is not to be overlooked. In the letters too, as previous quotations showed, there regularly appear declarations that essay-writing is amusing and instructive.

In the next place essay-writing serves the important end of stimulating the pupils to exert their powers. Thoroughness is greatly enhanced when the pupil is required to write down the results of his investigations. The zeal for discovery becomes very keen. The work of observation, instead of being performed in a slipshod, casual manner, as is otherwise the tendency, acquires instead, from the knowledge that all the observations must be written down, a character of something like

exhaustiveness. Anyone who makes notes on any subject cannot fail to have noticed this in his own case.

It is a particularly important point that the power of observation is developed in so high a degree by the direct observations which the pupils make before and during the work of writing. To illustrate this I append a copious series of quotations. They are arranged roughly according to the pupil's age; the Roman numerals following the quotation indicate the class of the "United Church Schools," where IV stands for the *youngest* class, while the ordinary numerals refer to the Intermediate School, in which Class I corresponds to Class IV in the other.

Some of the best observations are the following:

The lark is brown with grey spots. It is the edges of the feathers that are grey (IV).—The cat's tail is long; and it can make it thick when it is afraid (IV).—The flower [of the buttercup] is yellow and glossy on the inner side but not on the outer (1).—The flowers [of toad-flax] are yellow, but they are yellowest inside (1).—Inside the hazel buds the leaves are packed together, and they are greenish and covered with small hairs (1).—Most of the hazel's buds are small and red-brown, but green in towards the stem (1).—From the side-ribs of the oak leaf there go out again small, fine veins. Some of them lie exactly opposite each other, others are askew towards each other (1).—When one looks carefully, one can see stripes in the tulip's bulb-scales (1).—When one presses on an aloe-leaf close to the point, it is hard to the feel, but if one feels further down by the base, one notices that it is soft (1).—The scolopendra's* feeler is divided into joints, but I am not sure whether it is divided into 16 or 17 joints. After the head there come 21 body segments (1).

* A foreign large kind.

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In the core [of an apple] there are five spaces; in each of the four spaces there are two seeds, but in the fifth only one seed. The seeds are flat on the one side, and that side is turned towards the middle of the apple. The seed has outside a hard, brown shell. Outside, this shell is naked but the inner side is covered with soft down. Inside this shell is a transparent, fine membrane, which is reddish-yellow (III).—On the 14 bone-rays in the perch's first dorsal fin are sharp points (III).—The spined stickleback has 16 small three-cornered spikes on his back (III).—The lower jaw of the frog is soft to the touch [therefore without teeth] (III).—The largest scales of the perch are on the sides, they are less on the back, but on the belly they are least (III).—The flowers of the lilac are blue; but on the under-side they are more reddish. . . . The filaments are firmly fixed behind on the anthers (III).—When I looked more closely inside the rye-seed, I saw that some of the white stuff was crumbly like flour, while some was sticky like dough (III).—Besides [the juice in an orange] there is a membrane, it is transparent; for it is the juice that is yellow. Outwards is found the place where the membrane is thickest (III).—On the largest petal [of the violet] there are some large blue veins which lead in to the bag; and I saw that it was a tube, while everywhere else was closed with a tuft of fine hairs which was to be seen on the four other petals but was lacking on the largest (III).—The pea's [primary root] is white except at the point where it is yellowish green (III).—Under the beak [of the jackdaw] there are some white feathers. . . . Under the toes there are things like small cushions (III).—At the beginning of the beak [of the garfish] the teeth are small, in the middle they are biggest, further out they are small again. . . . The teeth in the upper jaw are bigger than

in the lower jaw. . . . All the edges of the fins that are turned forward are thicker and harder than those that are turned backward. On the tail-fins both edges are hard (III).—The barbs on the one side [of a feather's vane] are longer than on the other side, or rather straighter; the rays on the one side stand up more perpendicularly than on the other. But this does not apply to the feathers of the tail; for these, as far as I can see, have equally long barbs on both sides of the shaft (III).

If one cuts the germ [i.e., primary root] of a brown bean through lengthwise, one sees that inside there is something like a little sinew; but it is not properly visible as it has about the same colour as the rest of the germ. But if one then pulls it right out of the germ, one can see that it really has a kind of sinew inside the germ. This little sinew is nearly transparent and not thicker than a small needle (II).—The three petals [of ragged robin] are covered by each other to the half part, one is completely covered and one is not covered at all (II).—Inside [a pear's] stalk is juicy, and in the middle is something green which can be taken out, so that it becomes a hollow groove [i.e., a pipe]. Outside the stalk is a membrane which is hard to get off. When one chews the stalk one notices that it is very tough, and it can hardly be chewed in pieces. . . . When one cuts through the pear lengthwise, one sees that the stalk continues right down into the pear (II).—The leaves of the cockle are covered with fine hairs, which are longer inward towards the stem than at the lip (II).—On the inner side of the beak [of the shoveller] there stand out a number of spikes which forward towards the tip of the beak turn their points inwards, but along the side of the beak they are long, and here they point downwards (II).

When the stork found something, it took a little run, on which it rose high in the air and flew home to its nest. . . . It did not use its wings in the same way as a pigeon. That is, it did not strike with its wings inwards towards its body but waved them in the air (I).—In front [of a quail's metatarsal bone] there are two rows of large, yellow, clear scales; behind, there are several rows of small, yellow, clear, six-sided scales. . . . The toes are covered above with a row of large, yellow, four-sided, oblong, transparent scales, and underneath are covered with a folded, scaly skin. . . . Between the three foremost toes there is stretched out right inwards towards the root a quite little scale-clad skin (I).

From these quotations there cannot be seen any obvious growth in the power of observation. They rather give the impression that the power of observation is at once revealed in its full strength as soon as the pupil, at the age of ten to eleven, obtains the right opportunity to observe. Yet this is not the case. From the individual pupil's first and last essay it can be seen that in the course of the years there not only is acquired a much finer power of observation, but also that it is used on a much more comprehensive scale. In the youngest pupils' essays the good observations are as a rule merely oases in an otherwise ordinarily good account of the objects' qualities; *but in the case of the older pupils the whole essay is often a collection of excellent, fine observations.* To illustrate this I will quote two essays by the same pupil, the one from Class IV, the other from Class I, written June 18, 1906.

"*The pea.*—The pea itself lies in the pod, which consists of two long shells which lie fixed together on the stalk. Every other pea is attached to the edge of the one shell and the others to the edge of the other shell. If

one cuts through the pea one can take a rind off it and see the germ. The pod is inwardly covered with a thin membrane. If one holds the pod in front of a light, one can see that it is traversed by something that looks like thin sinews."

"*The devil's bit** is a weedlike plant. It has a green, juicy stem, thickly covered with small, stiff hairs. The stem may be up to an ell long and is erect. The leaves are sessile. They are placed oppositely, are green and distinctly lobed and plumed. In each corner is a shoot which again bears leaves, but these are very small and whole-edged. At the end of the shoot is an inflorescence. At the extreme end is the involucre, i.e., 15-20 small, green, whole-edged leaves entirely covered with hairs. Inside the involucre are the separate flowers, each of which has a little stalk to itself. On the stalk is a little, green conjoined [i.e., gamosepalous] calyx, the separate sepals of which end in long hairs. Inside the calyx is the corolla. This consists of four conjoined petals which are white in the part where they are united, the so-called corollatube. The free part of the petals is lilac, but the transition from white to lilac is quite gradual. The petals have a form like . . . not finished.† P.S.—The whole plant's structure seems to indicate [that the inflorescence is] a corbel, but as the separate flowers are stalked I am not sure whether it should not be called an umbel."

While the pupil's power of observation is revealed and developed by natural history essay-writing, it comes to light at the same time that children quite early reason about casual relations, and that they may have their independent

* This plant had not been shown or talked about in the class before the pupil received it to observe and describe.

† By these words the pupils signify that at the end of the hour they had not wholly described the object.

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reasoning and judgment on the questions concerned greatly developed by this form of written exercise.

A few quotations will best illustrate the point. " The lowest buds on the cherry-tree bough were not nearly so well developed as the others, I suppose because they had stood in water. (IV).—Will not all the fallen leaves manure the earth in the course of years, and must it not so rise higher and higher ? (1).—The perch can lay the rays of its fins along its back, just as one can close the blade of a pocket-knife. That is of great use to it, for otherwise it might easily stick fast in seaweed or other water plants (1).—The wood-snail's eyes are on stalks, and one may well suppose the reason to be this : it has great difficulty in turning, and it would be too troublesome for it to look around ; but now it can turn its eye-stalks and look behind itself (1).—One can see from the front legs of the gryllotalpa that they are meant to dig with ; for they are like a shovel (1).—The scarab has two small mandibles ; they do not need to be specially strong, as it lives on soft food (1).

There is a thin skin on the (anemone) stem, which no doubt serves to retain the moisture (III).—On the underground stem of the hop there are no thorns, but then they would be of no use here (III).

On the sides of the scolopendra there is no shield ; is that because the legs are attached there ? (2).—How does it come that butterflies are variously coloured and have not all the same colour ?—It is long-trunked insects that take the honey in the lilac-flower. I can see that, because outside the pistil and stamens there is a long tube, so those that are to have honey from this flower can only reach it with the help of a long trunk (2).

A cut apple gets brownest below the core. The core itself does not go brown ; and from this we can see that

the core consists of other materials than the flesh (I). —One evening I was observing a daisy and saw that little by little it raised all its petals until at last they closed above. Another time I was looking at another daisy. It was clouding up for rain, and I saw exactly the same, in that little by little it raised its petals and at last let them meet above. It might indicate that they closed themselves to protect the pollen against cold and rain (I).—This proof that the home pigeon is descended from the rock pigeon seems to me nonsense ; for then we should have primitive men produced by the crossing of human races (I).—The white mouse must have extraordinary muscular power in its tail ; for when they run they hold them lifted off the ground throughout their length (I).—It might seem as if there had at first been a skin stretched between the second and third toe which the oyster-catcher perhaps had no use for, and which has therefore disappeared in the course of time (I).

It is of great value for the development of the power of thought that natural history essay-writing causes the children to avoid generalizing from a single instance and to wean themselves from over-bold inferences from analogy.

Time after time in tram-cars and railway carriages, in the streets, and on other casual juxtapositions, I have heard small children, aged from four to six, reason thus : This is the same carriage (tram-car) as the one we rode out in, because that one too had such a thing (placard). This was said by a boy of about four to his mother. It was a placard about stopping-places that he was looking at.—A little girl, who had just come from an omnibus into an electric tram-car, said, on seeing an omnibus move forward : That was the one we came in.—That's the same train we were in before, said a child of three to four years, because there are the same holes (over the

doors) as before.—The little swans are not good, they go away from their mother, said a little girl in Frederiksberg Park.—Another little one, referring to a white dog, said to her mother: Mother, it wants some chocolate.—A boy of five* said to his mother: It's the same tram-car we were in before, and pointed to the seat-covering.—A twelve-year-old boy, on seeing a frog-fish at Belle Vue, said: That's the one we saw before, though it was half an hour since he had seen the first.

As inferences of this kind, though somewhat less bold in character, are perpetrated by many even at an advanced age, it is of importance that natural history essay-writing, in conjunction with independent observation, has the effect of causing inferences from analogy and uncritical generalizations to yield place to a self-imposed caution as to generalizations and faulty inferences. This I propose to show by the following quotations from essays: The electric eel which I have seen has five black spots on its back (III).—In the orange which I am describing there are 12 pieces (III).—It is not on all seeds in nuts that there is a brown rod (on the seed-shell); for I looked at several seeds. But in the nut I am here describing there are a number of brown and black spots (III).—There are 14 fruits in the seed I am describing (III).—The orange I was describing was divided into 10 small parts; but it is different (I).—On my apple there is a pear-like (i.e., pear-shaped) excrescence (I).—The skin on the cherry I have is light red and quite clear (I), etc.

In addition, while writing essays in school, the pupils make it manifest that they have a much more alert sense of responsibility than that which can be observed during oral

* When the age is given definitely, I inquired it from the child or a person accompanying it.

instruction; and this also appears in the essays. Essay-writing calls forth inwardly-directed doubt and criticism. In illustration I will adduce some questions put to me in a class during an hour's lesson; I have not noted them all, but only the more interesting ones. In a Class IV of the "United Church Schools," during essay-writing on articulata and worms it was asked: (1) Is that a joint? (2) Are these mouth-parts? (3) Are there mandibles (in the larva of the water-beetle)? (4) Is there a sucker (on the leech)? (5) Are there pincers (on the land crab)? [It was its foremost pair of legs.] (6) What should one call the abdomen (of the dragon-fly)? It is not properly round. (7) Have there been legs (in the willow-borer larva) on the segments which now have no legs? (8) Is this the sting (of the wasp)? And so forth. *The questions do indeed reveal uncertainty with respect to quite elementary qualities of the animals described, an uncertainty which, of course, also occurs in pupils who are taught orally, but which is then not revealed so candidly.*—In another Class IV the following questions came up in an hour: (1) Have all plaice the same number of spots? (2) Is the squirrel's tail the same at the tip in nature as it is here? [It was slightly split.] (3) Has the squirrel other teeth besides the front teeth (which were visible)? (4) Has the barbot teeth in the upper jaw? (5) Is there one tooth or many in the scaly-finned fishes? (6) Are the plates on the sea-turtle made of bone? (7) Can one call the barbot yellow with white spots? And so on.—In a Class III there was asked in an hour: (1) Is the toad plump? (2) Can one call the skin (on the frog's hind legs) a web? (3) Has the salamander a comb like that in real life too? [It was a specimen preserved in spirit that the boy was describing.] (4) Are there nostrils (in the salamander)? (5) One wouldn't think the tortoise

could draw its head inside the carapace. Can it? (6) Is that web (between the front toes of a toad)? (7) Must I call this the tail-root (in the lizard)? And so on. —Even in Class I questions are asked during essay-writing on very elementary things, e.g., the following: (1) What is this called? [It was the foot of a leaf.] (2) What is the name of these? [The small plates in a compound leaf.] (3) Is this the calyx (in briony)? (4) Is this stem woody or herbaceous? (5) Is this the style (attached to the tip of the pea-pod)? And others.

In the essays there also appear, as already said, greater caution, doubt, self-criticism, as the following examples will show: I do not rightly know whether there are two or more feelers in the ground-beetle (1).—It is as if the ground-beetle's legs were divided into three large segments and then again into many small segments. Is not that correct? (1).—I can see 7 rings on the leg (of the lark); whether there are more *I do not know*, as the upper part is covered with feathers (IV).—On the belly of the barbot there are two spikes; they are *surely* the abdominal fins (III).—It was remarkable to see how the pea could roll in the sawdust, which *I believe* depends on which side the pea was laid on (III).—Outside the seed (in a hazel-nut) there is a brown rind, which, *so far as I can see*, is divided into two layers (II).—At the other end (of the apple) is the flower, which, *according to what I can see*, has four petals (I).—*I do not know* whether the elevation in the middle is the ovary. . . . Is the flower perigynous? . . . I do not know *definitely* whether it is a composita. The stem (of sium) is smooth, *as far as I can see* (II), etc.

The essays in addition often show that the pupils have had a desire to prove their assertions. This desire may well be an effect of the total instruction given them; but

it does not manifest itself observably in the oral treatment of a subject; in any case I cannot remember a pupil ever asking leave to demonstrate anything, and I have no notes to that effect. But when pupils, left to themselves, write about something which they have directly observed, the desire for proof comes to light. A few quotations may illustrate the point. A boy writes: When fowls are sitting on their perch, it looks as if they only had a short neck. Now it may be shown clearly that such is not the fact. If, for example, one claps one's hands when all the fowls and chickens are out, one sees at once that they all stretch their necks together (II).—One can easily convince oneself that there is sap in the stem. By merely cutting it one sees that sap comes (1). —In the pear is a juice, which is sweet. . . . I can prove that in this way: When I had taken the stalk off, I pressed the pear, and a juice collected, which was sweet. —As proof that the poison-claws of the scolopendra are not attached to the head, this may be urged: if one follows the first segment up to the head, one can see that they are attached not to the head, but to the first segment (1).—Outside the bulb of the tulip there is a brown rind, which is no doubt formed from the outer layer of skins which have withered; for if one picks the brown rind off, brown spots are formed, which gradually become larger and larger until there is a complete rind again (1).—The leaves of a fern are like a bough with leaves on it. But they are one leaf. I can see this from there being a little leaf at the end of the stalk (2), with others.

The feeling of being under the onus of proof is revealed indirectly by the honesty with which, in the essays, the confession is made that the writer is ignorant of this or that or cannot see it. But, of course, honesty is not exclusively a product of essay-writing. As, however, it is so valuable

a thing, it is not without importance that it is displayed much more frankly in the essays than in the course of oral instruction. Presumably the written word is felt as more binding than an oral statement made in class ; for the honesty is not the consequence of any injunction to show a special degree of that quality in the essays. On the other hand, there is probably some force in the pupils' knowledge that I do not lay particular stress on their occasional mistakes or exhibitions of ignorance.

I will give a few examples of honest confession : The flowers are very small, so that I can count neither the petals nor the stamens (I).—I cannot properly see the veins in the leaves (of toad-flax) (I).—Dragon-flies are said to have feelers, but I cannot find them (I).—I have looked for the ears (of the sea-turtle) but have found none (I).—The sepals (of pericum) reach right up round the buds ; and there are some fibres above which I don't know the nature of (III).—On the front legs I could not see how many toes the puma has (III).—What sort of things are those like stamens fixed high up on the stem (of the wallflower) ? (II).—On some pears there are black spots ; I don't known what they are (I).—I looked for the ear-holes (of the crocodile) but did not find them (I), and so on.

But essay-writing in combination with direct observation has perhaps its greatest importance in the fact it provides good conditions for the development of the pupils' initiative. Of their own accord they think of starting investigations for which an oral treatment of the subjects would never give them models, and of which I cannot be the direct originator. In its simplest form initiative shows itself merely by the pupil setting about his investigations under somewhat unusual conditions ; but in its more developed form it expresses itself as truly independent

investigation. Some quotations will illustrate more exactly the nature of initiative : When one *pulls* a leaf off a thistle some thin threads come with it (I).—If one *splits* the stem, one sees quite a number of long, white tubes (I).—The leaves of mallow are saw-toothed and when one *feels* them they are soft (I).—When one *strokes* a puff-ball with the hand the small lumps come off (I).—By *cutting through* a bud (of toad-flax) I saw the ovary, the part of the style which is down in the bud, together with the seeds. *I looked through the magnifier* at the seeds and they seem to look like a raspberry. Inside the style is green, outside it is white (I).

The stem (of the toad-flax) is tough. One can hardly bend it without *twisting* it (I).—When one *scrapes* a little at the bark of a birch, one sees some white threads (I).—The stem (of comfrey) is very tough. After *breaking* it one sees as it were a number of strings lying inside a tube. When one *splits* the leaves along the stalk one sees a sort of transparent skin (I).—If one *takes off* the outside membrane of a lemon, and *allows* the lemon to lie for a while, it gets sort of dried (IV).—If one cuts a slice of carrot and *holds* it up before the light, it looks as if the innermost part was a sun sending out rays on all sides (III).—Once I *scratched* a little mark on one of my nails, and after a couple of months it had moved a long way towards the finger-tip (II).—It was not long (after I *had laid* crumbs of rye bread and white bread out on the window-sill to see what the sparrows liked best) before I discovered that the sparrows were there again eating the crumbs. I sat on to see what they would eat first. I soon got to know, for it was not long before all the white bread crumbs were gone (II).—If one were to *eat* (i.e., taste) the leaf (of lilac), one would notice that the taste is very bitter (II).—When one holds (the leaf of charlock)

up towards the light, the veins are light (II).—I *placed* a thimble over one of the peas to see if it would sprout (II).—If one *cuts* a slit in a plum a depression comes there. One can see from this that the skin is stretched tight (II).—I *tasted* one of the (pepperwort) seeds, and it was bitter. On April 9 I *felt* one of the seeds, and noticed that it had become extraordinarily soft like a gooseberry (I).—On the stalk (of the evening primrose) there are small hairs like little black dots when looked at from above ; but *if one looks at them from the side*, one can see that they are hairs. The stem is hard. One notices that when one *pinches* it (I).—When one *pulls* off the membrane from the inside of a pea-pod and then *looks through the pod*, it is full of fine veins like a leaf (I).—The shell of the apple-seeds does not *taste* of anything. Inside is some white flesh which *tastes* excellent (I).—The skin (of a rhubarb-stalk) is smooth outside, but sticky on the inner side. One cannot tear it across, but lengthwise it divides of itself (I).—In order to obtain fruits (from a lily) I *strewed* the flowers with the pollen of a fuchsia (I).—I put an orange-seed into wadding, because I wanted to see what would become of it (I).—When I went the same way on October 26 the leaves were yellow. I now resolved to go that way from school every day so that I could properly see the changes in the leaves and their diminution in number from day to day (I).—When I *raise* the woodpecker's tail away from the tree-trunk I notice that it is pressed fast to the trunk by its own strength (I). And others of the same kind.

Another very important consequence of children writing on matters which they have themselves observed and in which they are really interested is that their language is enriched in various ways. There is therefore a strong contrast between the child-language in the ordinary

" Danish compositions," " reproductions," etc., and in the natural history essays. But then it is not to be wondered at that children should come to write unnaturally when they are given, at the age of fourteen, such themes as this : " Remember that thou art dust. Remember that thou art more than dust." From essays handed in to a teacher who set such themes as this I have culled flowers of speech like these : " In the sky hung the rain-fraught clouds," " The eagle, poised aloft, scans the ground with a gaze worse than that of a Xantippe," or " The crow, who utters his hoarse cry while eating the corn," or " How strongly do the birds, these winged creatures of God, engage the attention of all. The little lark, the happy, little nightingale . . ." etc. If it were genuine there would be less ground for complaint ; but it is only too obvious that the phrases are those of the teacher. The pupils have not learnt to write for themselves. They have grown accustomed to write with a guided pen. Their independence has been kept down, whereas it ought to have been strengthened.

In the natural history essays there are no false lyrical outbursts, or anything else that is spurious, but on the other hand there are often amusingly fresh words and expressions ; and these present themselves as early as the first school-year. This may be shown by some quotations from the essays of the Intermediate School pupils, e.g., the following : When one takes off the petals (of mallow), the whole flower (i.e., the remainder of the flower) is like a fountain (1).—When one looks at a forest from outside it looks like a great heap of leaves all close together (1).—The bark of the oak is thick and crumpled. All along the edge of the leaf there are as it were waves (1).—The oak's trunk is very knotty (1).—On the scarab's legs there are some bristles, so the legs are well equipped

for digging with (1).—On the thorax of the privet hawk-moth there are some fine hairs, placed close together, so that it looks as if it had a waistcoat on (1).—The first tree we saw stood quite by itself. Thus it had leave to spread out on all sides, while the trees that stand close together are sort of gnawed off on the side they turn towards the other trees (1).—In the petals (of charlock) there are small veins that spread out like a jet of water. The leaves belly like a basin (1).—The flower (cornflower) is blue, and consists of some small petals which are hollow like a wine-glass (1).—The root of the crocus-bulb is like a broom (1).—The top leaves of those lying on the forest soil were dry, but the bottom ones were wet and some were smutted (1).--[The drakes in Frederiksberg Park have], where the green on their heads stops, a white stripe round their necks, so that it looks as if they had a collar on (1).—The veins in a beech-leaf are very plain and lie like ridges of hill in a country (1).—The roots of the daffodil are white and are like white yarn (1).—The small leaf of the horse-chestnut is not much indented, but is regularly jagged like a saw-blade (1).—The bark of nerium is shrunk (1).—The perch can lay its fin-rays along its back, as one can shut a pocket-knife (1).—In the hindmost dorsal fin (of the perch) there are soft rays ; that is, the rays stick out like the bristles on a broom (1).—We saw Spanish dancing mice that run round as if they were not right in the head.—The varanus's skin looks as if it were knitted (1).

In some " Danish compositions " about a fire, too, there is evidence of the value of personal observation in contrast to the imitative essays. One wrote : " Now came Falk's salvage corps marching along the street with a crowd of children after them ; " another : " The fire had started in one of the houses, and had already burnt

it down " [corrected by the teacher to : " which already had been burnt down "] ; and later : " The firemen steadily sprayed water on the fire ; " a third : " It was a fine sight to see the whole factory in bright flame," and so on.

By way of supplement some quotations containing specially striking words and expressions are added from essays in the " United Church Schools " : The grebe has separate webs for each toe, so that it looks as if it had gloves on (IV).—The kite looks very grim (IV).—When one feels the leaves they scratch, as if there was sand on them (IV).—The horns (of the cow) are like a whole lot of cornets stuck inside each other (IV).—The claws on the hen's toes are like a shovel turned backwards (IV).—When the peacock walks, it walks as if on pins (IV).—The sucker (of a wolf-fish) has some likeness to a clock-face (III).—On the side (of a wolf-fish) there is a row of points which are like the thorns of a wild rose (III).—In the mouth of the perch there are some tiny little teeth which feel like fine sandpaper (III).—The herring looks so bad-tempered, because the lower jaw is longer than the upper one (III).—The hind wings of the mole-cricket are like thin linen (III).—The leaf-stalk of the anemone is as if cut open on one side. The anthers are like a bean with a crack along it (III).—The calyx of the poppy can be divided into two parts like a folding door. When the bud unfolds, we see the petals like crumpled-up cloth (II).—The seeds (in asparagus berries) are quite white inside like porcelain (III).—When one peels off the skin of a gooseberry, inside there is something yellow in which there are stripes like yellow sewing-thread (III). —When one looks really closely at the flesh of an apple it looks like foam (III).—The secondary corolla (of narcissus) is round like a pot (III).—Besides, I watched

how a cow chews the cud. I lay in the grass and looked at a cow. All at once it said " Öh," and I could see that it was beginning to chew. . . . When it had finished the mouthful, it lay quite still and did not move its mouth ; but " Öh," and so it began again (III).—The feathers (on the hawk's leg) lie as if they had been blown inside out (III).—When the bastard carp gapes, the upper part of its mouth is like a round open porthole (III).—The cow's tail is like a whip-handle, and out at the end are a number of small lashes (III).—In the evening we heard rats in the maize, and then they scuttled off as though one had beaten quick time on a table with one's fingers (III). —The stork had long, thin legs, and stepped so cautiously with them (III).—The pea with the shoot makes one think of a swan's neck and head . . . the leaf (in the germinal bud) is thus folded like the binding of a book (II).—On one side the seed (of barley) is like a loaf with a deep crack along it (II).—The anthers of the tulip are like a closed book (II).—While putting out roots the peas at the same time opened somewhat like a sea-shell (I).—To-day the tulip-flower opened for the first time so as to look like an opened umbrella (I).

Finally, natural history essay writing has extraordinary value as a source of knowledge about the pupil. All the observations that have been cited respecting the effects of essay-writing, whether alone or in combination with other methods of instruction, constitute experience bearing on the mental states of children ; and there can be no reasonable doubt that a far less utilizable material is provided by children's dictation-essays, reproduction-essays, or free essays on subjects lying outside their direct experience, as e.g., the previously-mentioned essay on " Dust," or the like. In natural history essays, or other forms of composition resting on the pupil's direct

observation and not transcending his stage of mental maturity, the whole being of the pupil is revealed in a much higher degree than in essays on subjects outside his experience, or in oral instruction. This has often struck me with special force in connection with the references in the essays to a particular question.

While, for example, I do not know that I have ever, during oral instruction, heard pupils express their views on the mental life of animals, this subject often comes to the front in their essays. But it is not a modern theory to the effect that animals have a mental life as truly as man, though in a less perfect form ; for when I have taken occasion from remarks in the essays to ask if it was seriously thought that a lamb meditates, and so on, the pupil has always retreated from his assertion. It is possible, however, that this is a result of the religious teaching, which tends to impress upon the children that animals have not a soul like man. Possibly it arises from the further ground or the sole ground, that children, on reflection, do not take it for granted that animals have souls. In their essays, however, they betray a view of animals as endowed with soul analogously to man ; and it is probably the primitive animistic conception of nature that here comes to light.* This seems probable for the reason, among others, that it is not only the higher animals, as the mammals, to which mental life is attributed, but also animals quite low in the scale, as will appear, e.g., from the following quotations : When the gold fishes have received their food they do not eat it at once, but lie chewing at it ; at last, however, they *take it into their heads* to eat it (IV).—The coachman, who was frightened, jumped from the carriage ; but he was unlucky and made

* See St. Hall: "Ausgewählte Beiträge zur Kinderpsychologie und Pädagogik," p. 173.

a bad jump. The horse saw it and *went mad* over it (IV). —[A lamb left the flock] and walked *meditating* towards a reddish bush (III).—The sparrow was forced to make a present of the worm to the starling, which set about eating it, while the sparrow had to pike off and be content with twittering *to ease its grief* (III).—In all respects the male (of my salamanders) was *cleverer* than the females. —The dog, however, *did not lose courage* but went to lie in wait behind the planking (III).—Kvik was a really *angry* horse (III).—When Peter (a horse) heard a trumpet, he *jumped with joy* . . . when he could not find me, he ran home (III).—Peter was a pigeon . . . ; and of Peter's *cleverness* there are many examples ; but I will only mention the following : One day I was sitting reading at the window, but it was closed. Then Peter came flying, and *wanted to come in to me*. But when he saw the window was shut he settled on the eaves and *waited* for me to open it. I pretended, however, not to see, and immersed myself in my reading. Suddenly I heard someone knocking on the pane ; and when I looked up I saw Peter standing outside knocking with his beak (II).—None of the salamanders *wanted* to take the worm ; when two of them were up at the surface, the one down at the bottom *resolved* to do so (II).—The dog was all the same *envious* of the cat (II).—So they (the ducks) *talked* with each other awhile. . . . [When they then found each other] not *a word* more was *said* (II).—As soon as the man put his coat on, Tille (a dog) flew at him ; he *thought*, apparently, that he wanted to steal (I).—While I was in the country during the summer holidays, I noticed how great *love* a cat has for its kittens (I), with more.

One also learns to know the æsthetic characteristics of children, or, more precisely, their mode of expressing the æsthetic impressions made on them by nature. These

expressions, however, are very far from conforming to the grown-up person's use of language. It is even probable that children are capable in only a very limited degree of giving their æsthetic perceptions verbal expression. They succeed better with the paint-brush. If words have to be used, they do not as a rule rise to more than the commonest words and phrases ; it is a real rarity for a remark of æsthetic import to occur in an essay. I will quote a few typical examples : The flower (buttercup) is really pretty (1, girl).—The flower (mallow) is blue and very pretty (1, g.).—We found a number of vineyard-snails. Some of them had nice shells, others were not pretty (1, g.).—Sometimes moss grows on the trees, and that looks nice (1, g.).—It was a lovely sight to see all the big factory in a bright blaze (1, g.).—In October Søndermarken is very pretty. In the autumn I often go into Søndermarken, because it is so pretty (1, g.).— Towards spring the forest gets its green dress again ; then it looks beautiful, and a splendid sight meets the eye when one goes out into the wood in spring. Flowers are there by thousands and lovely soft leaves and grass which one can lie on (III, b.).—The grass in many places is still very green, and it is a pleasure to see it round about in the wood and park so late in the year (I, g.).

That children so seldom reveal their æsthetic perceptions is, as already said, no sign that they are only now and then æsthetically impressed. But it is doubtless due in part to a kind of modesty in regard to the emotional life, a fear of exposing themselves, an instinctive perception that in this field the adult is so superior that he finds the child's emotional outburst ridiculous. If children are directly called upon to be æsthetic, this readily leads to quite spurious outbursts, like the one already quoted (p. 113) about the happy little nightingale.

There is still another department in which essay-writing reveals interesting qualities which otherwise often remain hidden; that is, it provides for checking to a certain degree what the pupils really know and can do. In oral instruction it is so easy to be fooled. The teacher explains or lets the pupils explain a term such as "corbel," a form of fruit, or the like, and then he is in great danger of assuming that the pupils are now fully enlightened. But let them come to write about a cognate matter; they very often betray the fact that their comprehension has been very superficial, and that the teacher has been the victim of one of the educator's many illusions. Thus a boy in the Intermediate School writes as follows about the leaves of the horse-chestnut: "They are very large. They are pinnate and placed close together. The leaves are pointed and broadest in the middle and end in a point." Here he has taken the platelets for independent leaves. A ten-year-old pupil in the "United Church Schools" wrote: "The carrot is a root-fruit;" another: "The pistil (of a tulip) consists of ovary, *style*, and stigma," and a third: "The pea's leaves are placed by the side of each other": he thus, like the first-mentioned, confuses leaves with platelets. Many such errors, contained in the essays, reveal the dangers of lesson-reading. It is especially the younger pupils, coming from schools where they have learnt by heart, who talk about the "style" of a tulip because they have learnt that a pistil consists of ovary, style and stigma. A pupil in Class 1 Intermediate writes: "Outside (on the sunflower) are the sepals, they are thick and well covered with hairs;" and another: "The flowers of chrysanthemum consist of a mass of sepals and a mass of petals," and so on.

PHYSICS ESSAYS

The writing of physics essays has, in most respects, proved of many-sided importance in the same way as the natural history essays; but as the "United Church Schools" had no laboratory for the pupils, it was only in a limited degree that they were able to work independently on physical phenomena. Still, something was achieved in this direction. Two hours a week were allowed for instruction in physics during the last two school-years, corresponding to the third and fourth classes of the Intermediate School. As basis of instruction Borgen's "Nature for Elementary Schools" was used; and following this I went first through magnetism, then electricity, and later the remaining parts of physics. As previously stated, the first attack on the subjects was made by the method of desk-conversation, the pupils helping with the experiments. But at the same time I taught the pupils how they might make still simpler apparatus than that mentioned in the book; and the school lent each pupil a magnet, a chromic-acid battery, an ebonite rod, and a glass rod for home experiments. With this scanty apparatus the pupils made experiments at home and described them in essays; and particular pupils made apparatus themselves. After the sections named had thus been gone through, the pupils received the school apparatus to make experiments with, or at least to observe them. The pupils worked together, two by two, and the apparatus went the round in a definite order. But as this experimenting took place in the ordinary class-room on tables not calculated to stand acid-spills, and in such-wise the children's books and clothes were exposed to damage from liquids, I had

to exclude all experiments in which liquids, especially acids, would have to be employed. Still, chromic-acid batteries were used in addition to dry elements.

While the pupils were making experiments or watching apparatus, they were permitted to use their text-book freely, and naturally they could ask me about all they had any occasion to ask about. Each pupil wrote down in a notebook what he had observed relating to the matter dealt with in the book.

This experimenting interested the pupils in a high degree. This appears not only from their letters and spoken declarations, but also from the fact that the unavoidable noises of the apparatus, the ringing of electric bells, the crackling of sparks from an electric machine, the flicking of cat's skin on the electrophone-disc, and so on, did not disturb them. Each gang of pupils worked at its own job unaffected by the noise. It is also a testimony to the interest taken that in the course of several years only a single object was broken, although the pupils fetched the apparatus from the collection themselves, distributed it in the class, and took it away again, without my supervision.

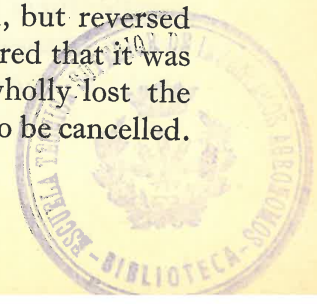
In the notebooks kept by the pupils, however, there cannot be detected any surprisingly big results of this experimenting for oneself. It did not very often amount to really independent observation. The reason may well be that the apparatus is too finished and shipshape. *Initiative is thus prevented from coming into play, and the pupil is content to satisfy himself that the apparatus will work as it says in the book and that he himself can make it work.* In spite of this I attach great value to the experimenting of the pupils. It is not only that they learn the construction of the apparatus and its mode of working by seeing it for themselves, and that they have occasion

to overcome small difficulties by their own resources, but they are also encouraged to do independent work at home. A number of them have, in fact, contrived various simple experiments at home; and if lack of money had not prevented them from making apparatus they would doubtless have made more and tried numerous experiments. In spite of scanty means many pupils have brought to school chromic-acid batteries, simple electroscopes, a multiplicator, an arrangement of pulleys, an inclined plane, a mill worked by a steam engine, a chocolate automaton, a money-box with secret fastening, a clock, a turbine, a steelyard, etc. Most of the experiments, however, have been made with a horseshoe magnet or an electric pendulum, and these basic experiments have been described in essays which are often excellent.

As illustration, I reproduce a few individual essays and short extracts from others.

A boy of thirteen writes in an essay on electrical experiments:

"I bent a thick bar of soft iron into U-shape and wound a quantity of very thin insulated copper-wire round each of the legs, but in opposite directions; but things did not go exactly right, as I and the wire were not agreed. I wanted it to lie tight round the magnet, but it wanted anything in the world except that. So then I wound it tight round and poured stearine over the lot; and now we were agreed. Then I connected the wires with the battery by twisting the wires leading from the magnet with the battery-wires. The iron then became so magnetic that it could nearly lift a pair of scissors. Then I cut off the current, and shortly after closed it again, but reversed (i.e., with reversed current). I then discovered that it was less magnetic; for as the iron had not wholly lost the magnetism from the first time this had first to be cancelled.



" I took an electric bell and placed it in connection with the one element. At first it would not ring ; but when I had got it rightly adjusted, it rang well, even when I touched the wire against the iron parts of the apparatus, as the bell, the hammer, even the metal cover. When I interrupted the current for a while and a little later closed the circuit again, there was a much stronger current ; but it grew weaker again.—On my brother's suggestion I put the two wires (from the element) in my mouth. At first I touched them with my lips. It was as if the wires were almost red-hot. But when I held them against my tongue I perceived a very strong acid taste."

In this essay there is testimony to initiative, victory over casual difficulties, interested observation, independent reasoning, etc., and similar testimony is afforded by many other essays. A few quotations will prove this, e.g., the following : " I had not believed before that a rubbed rod of glass or ebonite can attract steel ; but then the other evening I placed my ebonite rod close to a needle ; and then I saw that it was attracted " (II).—" When one pours water into a test-tube it does not place itself horizontally, but comes to have a surface that looks like Fig. 1.* I don't know whether this is partly due to the bottom of the tube being round " (II). [I recommended trying with a glass that had a flat bottom.]—" When one rubs an ebonite rod with a little wool, which, according to my experiments, I have found to be one of the best things for the purpose, positive electricity arises in the wool and negative in the rod. If one brings a rubbed ebonite rod close to the point of a knitting-needle, there come some flashes which are like an equilateral triangle [in which the lines from one of the vertices have divided] the opposite side into three or four

* The figure is here omitted.

parts. I could not see it accurately, as it went so quickly. . . . When one rubs the ebonite rod quickly and hard, there comes a greenish light on the wool. If one brings a rubbed ebonite rod near a round, good conductor, the spark is roundish " (II).—" In a little chromic acid apparatus, which I made for myself, I discovered the other day, on connecting it with a bell, that when the carbon and zinc are right out at the sides of the glass it could not make the bell ring ; but the nearer the zinc and carbon came to each other the more and better and stronger was the ringing . . ." (II).—" A rubbed ebonite rod can also attract water ; this rises up towards where the ebonite is placed and slopes downward away from that point. A little afterward a spark [leaps] across " (II).—" If an ebonite rod is rubbed and thereupon dipped in water, the electricity, if the water is cold, will at once disappear. But this will also happen even if the water is warm " (II).—" If one brings a not too strongly electrified ebonite rod near to one's nose, one will notice a feeling as if someone were breathing on it. If the ebonite rod is brought close to the nose, a spark leaps. At the beginning, when I first drew sparks, I did not think that sparks could come between the electrified ebonite rod and water ; but when I tried it, it turned out that strong sparks came. Sometimes the sparks are branched at the one end ; and that is always the end nearest the ebonite rod. If one brings the ebonite rod near the point of a knitting-needle, or of a knife, or any other pointed thing, specially long and branched sparks will come ; but they are thin ; [and] the finer the point, the longer and thinner will the sparks be. The finer the point, the weaker will be the crack. When one brings a rubbed ebonite rod near another ebonite rod, the spark will only be very small ; between

glass and ebonite it will be a little larger, but it is largest between conducting bodies" (II).—"I filled a wide bottle with pieces of the tin that is placed round the corks of wine-bottles, and filings. Then I bored a large hole in the cork and wound pitch or asphalt round the middle of a round nail, from which I had filed off all the edges. Then I wound pitch round the cork as well, warmed up the bottle-neck and the nail, and then inserted cork and nail. Then I covered the bottle outside with tinfoil about up to the neck; and when I then brought an ebonite rod, which had been well rubbed, close to the nail, I could hear a little crack. But I could see no spark, even though it was dark; neither could I discharge the bottle" (II).—"One day I took a small iron rod on which there was a screw-thread. I screwed a nut, which had been filed nearly round, on the one end. Round the other end I bound firmly two strips of tinfoil with silk thread. I laid this apparatus over a bottle; and then I had an electroscope. . . . I tied up the same apparatus with two silk threads; and then it looked like this (see Fig. —).* This last was the best, and with it I made some experiments. . . ." (II).—"I dropped some filings into a vessel of water in such a way that they remained floating on the top; and after that I put the magnet down in the same water, and the filings were more attracted than, for example, on the table. This must be because the filings are lighter in the water" (I).—"One day in November one of my sister's schoolfellows was at our house. I wanted to impress her, and . . . so I rubbed the ebonite rod in a pitch-dark space, and sparks came about $\frac{1}{2}$ to $\frac{3}{4}$ cm. long. Now comes 'the epilogue, and that is the grandest part of all' (Holberg's *Henrik*), for when I then asked my sister

* The figure is here omitted.

how long the sparks had been, she answered: 'about $\frac{1}{4}$ cm.'; but the other girl maintained, in answer to my question, that the sparks were 'at least 1 cm. long.' The moral is: Women are not good observers" (II).—"Wood [through which] my magnet [can act], must not be more than $2\frac{1}{2}$–3 cm. thick. I have tried holding paper between, and I found that the magnet could act through 175–200 sheets. If I placed no more than 100–125 sheets between, the needle could still hang on the other side of the sheets. If one conceals a magnet in the hand and brings this near the needle, the magnet acts through the hand" (II).

A particularly marked example of initiative and researcher-spirit is the following essay, which I quote *in extenso*:

"When one places a few small pieces of elder-pith on a table and brings near to them an electrified ebonite rod, then, when the rod is at a distance of about 1 cm., they will jump up on the rod, stay there a moment, and then fall down again, jump up again, and go on in the same way for a while. If, then, the rod, which need not be rubbed anew, is brought down close to the pieces of elder-pith, these may again for a while jump up and down; but when they can do so no longer, the rod must be rubbed again. The pieces do not all jump up to the rod at the same time, nor do they remain equally long hanging to it, nor yet does one and the same piece behave alike every time. When they fall down, they do not drop straight below the rod but are often driven 3–4 cm. away. It depends on the size of the pieces whether they can jump a long or a short distance to the rod. The small pieces jump farthest, but also fall down again most quickly, so that they are continually jumping up and down. The pieces of elder-pith can also, while

adhering to the rod, move a little distance along it, and likewise they can hang one under another, and stand on edge when one brings the rod near them. The ebonite rod can retain its electricity for about two minutes. When one unravels the end of a silk thread and brings the rod (electrified) up to it, all the separate fine threads stand out on all sides. Electricity cannot, like magnetism, act through paper. If one tries with tiny bits of wood or iron filings one gets the same result as with elder-pith. If one takes a silk thread with an elder-pith ball at one end and gets it to hang on the rod, the thread can hang longest and at the same time support the ball after this has dropped. I tried bringing the rod near a very small spider, and I saw that it did not go on walking but stood and turned itself round and bent itself all together, while its legs were drawn up and it was at the same time waving its legs about. One can take the electricity from this ebonite rod immediately by wetting it " (I).

From the experience I have gained relating to the teaching of Physics, I draw the conclusion that the pupils not only ought to acquire their physical knowledge for themselves by laboratory experiments, but that they also ought to have scope for independent inquiry. If they are told exactly what experiments to make and how to make them, initiative is checked. What happens then is the same as in the case of the ready-made apparatus in full working order, and the profit is not the greatest possible ; indeed, it is diminished in one of the most essential aspects, that which regards the growth of initiative. On the other hand, initiative is given the best conditions for thriving when a pupil, left wholly to himself, sets about experiments with simple means, e.g., a horseshoe magnet, needles, knitting-needles, nails, and the like.

CHAPTER V

ORAL INSTRUCTION

While the pupils' direct observation and independent accounts of its results have come more and more into the foreground, oral instruction has, at the same time, been pushed back. But in the course of years I have employed different methods of oral instruction and collected experience illustrating their various effects, and therefore I propose to deal with the changes of method, their motives and their significance.

Originally I made exclusive use of oral teaching. It was individual teaching thus arranged : First I went through the " lesson " in lecture-form, at the same time exhibiting preparations of the animals mentioned. In the following lesson I heard the pupils, one at a time. This pupil stood by my side and observed the object —on behalf of all his classmates. They had to be satisfied with listening, and verifying, if need be, whether the boy who was up reported the book or my statements correctly.

This method suffers from obvious defects. It is especially unfortunate that only one pupil observes the object that is being spoken about ; and it helps but little that later the object goes the round of the class. Partly because not all the pupils get a sight of every object that circulates, partly because the circulation has in any case

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the effect that the pupil engaged in observing the object is inattentive, while others are often distracted from the subject being treated of by the teacher.

Besides this lack of sufficient opportunity for observation and this disturbance of attention, the method has a further great defect, namely, *that the teacher's preceding lecture has prevented the pupil from being a first-hand observer when he actually has the good fortune to see the object of instruction*. He therefore does not see what involuntarily strikes and interests a child, but looks to see *if the plant or animal has the attributes mentioned by the teacher*. But this inspection for verification is not a true training in observation ; it does not make the pupil independent ; it does not rouse his initiative. It is perhaps interesting for the moment, but it does not develop a real deep-rooted interest in nature-study out in the open. In appearance it is direct observation ; in reality it is book-study with a collection of animals or a few cut plants as an intermediate link.

Starting from considerations such as these, I was early led away from the practice of " going through " the natural history lesson ; and when I later began to teach physics and geography I practically dispensed with that operation entirely. This, of course, has occasionally the consequence that the pupils do not fully understand what they have read in their text-book ; but that is a minor matter and is remedied in class when the lesson is heard. The main point is *that the pupils come into immediate contact with their book*, without the teacher's intermediation ; they learn to read for themselves—a thing they cannot learn if the matter is first chewed for them by a conscientious lecturing teacher. That some text-books are ill-adapted to the pupil's first-hand study is incontestable ; but that is the fault of the books,

not of the teacher who omits the " going through " process ; and if this omission becomes general, it will inevitably lead to more and more text-books being readable and fully intelligible to children.

The preference of the pupils is, without qualification, that the lesson should not be gone through. I have very often asked about this and always received the same answer. But of course the teacher must not be a rigourist about misunderstandings. Most emphatically he must not insist on the pupils being lesson-perfect.

The use of the text-book here described received increased justification when I introduced class-instruction. The impulse to this change was given by an article by Slomann in *Vor Ungdom*, 1897, Supplement II. Although Slomann drew attention to several apparent defects in the class-instruction which he had seen, I yet resolved to try the method, as he had found that there was a great deal of good in it. To begin with, however, I encountered resistance from my pupils ; they found it ridiculous that all of them should be expected to signify whether they could answer my questions. They gradually became reconciled to the method, but still it did not work satisfactorily. There was no go in the teaching ; the children were inert and spiritless ; I was on the point of abandoning the attempt. Luckily I resolved to try if I could not overcome the difficulties by a very careful planning of each separate hour's instruction ; for it now turned out that there was no longer any trouble. The lessons became " amusing." It often happened that when the bell rang some pupil exclaimed : " What, is the time up already ! " The pupils showed indirectly that they enjoyed the class-teaching.

But in order to be certain that the method really appealed to the children, I questioned them frequently

about it ; and now and again, as already stated, I had a vote taken. Both their answers, their votes, and their purely spontaneous declarations in letters have practically always amounted to a preference for class-instruction.

My observations have led me to the view that class-instruction has first and foremost the great advantage, as compared with individual instruction, that it makes time fly. It is not only that the hours have gone quickly for me ; I have had the impression that they went quickly for the pupils too. *But this not noticing the time, is the surest sign of full absorption in the matter in hand.*

Another advantage of class-instruction is that it leads to more questions being asked by the pupils than individual instruction does. That was one of my first experiences, after I began to practise class-instruction ; and it has led to two successful alterations in the method as described by Slomann. What he particularly urged against it, as he had seen it in Suede, was that it gave the individual pupil too little chance to assert himself. All the pupils become, as it were, a single mouth, inasmuch as they merely have to signify whether they can answer the teacher's question. *But as soon as they have leave to put questions, it is quite another matter. The individual comes into his own, while the essentials of the method are preserved.* The technical form for the pupils' questions is quite simple ; the " asker " merely holds up his hand or keeps it raised even when his classmates have put theirs down after a question has been answered. The teacher then knows that the pupil concerned has something on his mind. If the moment is for some reason or another inconvenient, the teacher signifies, by a deprecatory wave of the hand, that the questioner must wait a little. Otherwise the pupil is at liberty to put his question.

As the questions asked are often but distantly related to the subject under treatment, I early came to make a distinction between the questions which must at once be made the object of investigation, as a stage in the treatment of the subject, and questions which can be shelved without hurt. For questions of this kind I introduced " question-minutes " at the end of the hours, so far as time was not a prohibitive consideration. *As I shall show later by quotations, there came thus to be treated a multitude of subjects which otherwise would perhaps not have come up, and which, in any case, secured the concentrated attention of the class.* They were not imposed on the pupils by the teacher, *but contrariwise on him by them.* It even happened once during a written examination that a boy of twelve requested that the class might be allowed to put questions.

Another and more radical improvement in what was originally mere class-hearing came about when I modified the method in the direction of the true conversation. Of course one cannot converse in school on the principle of all speaking at once, or of allowing unseasonable interruptions. In school there must be an orderly conversation led by the teacher in such a way that when the pupils are luckiest they carry on a reciprocal exchange of ideas. The technique is thus, in essentials, much as in ordinary class-teaching, except that the teacher gives the pupils abundant opportunity for asking questions —and himself for answering them.

The external factor which led to my fixing on the conversation-method was that the school procured at my request a number of high stools, by the aid of which all the pupils in a class could stand round the desk or a large table. The animals being studied could then be seen at the same time by all the pupils under something like

equally favourable conditions; and pupils and teacher came to such close quarters with each other that the vocal tones employed involuntarily became those of conversation. But, of course, this method of desk-conversation can only be used in moderation. If the pupils show signs of fatigue, if they seem to have had enough of standing, they must be sent to their places. In practice, however, this happens only very seldom, and, as remarked already, the pupils prefer standing by the desk to being heard where they sit.

In the particular case it must naturally be the subject which determines what form of oral instruction is to be employed. If the lesson is a repetition, a general class-hearing will be appropriate. But at the first treatment of a subject it is natural to employ conversation, during which the pupils either remain sitting in their usual places or stand round the desk. The first arrangement is the most suitable when there is nothing to look at but large wall-maps, large drawings, e.g., of elephant or lion, or when the subject is observations drawn from home or street, e.g., the phenomena of heat, the use of the lever in daily life, and so on. But if a physical experiment is to be made, an animal or plant to be observed, then, without doubt, the desk-conversation is the right form for oral instruction.

It is not, however, possible to maintain a sharp distinction between conversation and lesson-hearing. In practice there is no doubt instruction most often takes the form of a hearing in which there are more or less of the features of a conversation. But when a subject powerfully stirs the minds of the pupils the conversation may become quite typical.

Whether class-hearing or conversation be employed, certain inexorable demands are made on the teacher, of

which, as experience shows, not all are sufficiently conscious. I am not thinking of such obvious matters as that the teacher must be master of his subject, and that he must have mapped out his procedure so carefully that he is able at once to meet the questions of his pupils and get in all the matter which he thinks ought to be included. These demands enforce themselves. But there are others, not so inescapable, which teachers frequently fail to satisfy.

Often the language used is deplorable, and questions are put in obscure or illogical fashion so that the pupils are indirectly invited merely to associate the question with a piece of the text-book, or to guess riddles instead of thinking. By way of illustration I will give a few examples. Such a question as: "What victory was it the Romans gained in the last hour?" is very unfortunate, for it sets the children's thought and imagination working on quite wrong lines. But one often hears questions of this type. But worse still are questions such as these: (1) "What could one do with the railings?" (Answer: "Look through into the yard.") (2) "Does the word 'child's' always look like that?" (Answer: "No, it is sometimes 'child.'") (3) "Which was how broad?" (4) "There came who in?" (5) "In, therefore, what place was the festival held?" (6) "After the Romans had conquered Judæa, what then happened?" (Answer: "Roman money was introduced.") (7) "Then there's the 'farmer's man.'" (A hand goes up and a pupil says that "farmer's man" is a noun, or the like.) (8) "Here's the word 'scared,'"—something is said in answer—"I would rather hear something else about 'scared,'" etc. (9) "So this line is then parallel to what line?" (10) "We are now in what part of the earth?" (11) "What does Australia consist of?"

(12) " This town is then how large ? " (13) " We are going to hear to-day about what sort of men ? " (Monks.) (14) " What then did Constantine do ? " (Answer : " He gave the free exercise of religion.") (15) " What then could the Christians do ? " (Answer : " Live in peace.") (16) " The three-quarters is, then, how many twelfths ? " (17) " Who knows some of all the beautiful names we have to-day (in geography) ? " and so on.

Merely from respect to our mother-tongue such slovenly speech is inadmissible. But it is further to be rejected on the ground that under cover of teaching children to think correctly, it actually trains them to defy the laws of logic.

Another technical fault frequently committed is that the teacher only addresses himself to the pupils who signify that they can answer the questions. In this way the slower minds, or, in general, the less-gifted, are left out in the cold. The teacher, therefore, must now and again, and not too seldom, call on one of those who have given no sign to attempt an answer ; this procedure, however, should not lose its character of an exceptional event.

If there is a choice between conversation and hearing, a previous learning of the lesson or lecture by the teacher, or both, being presupposed, the preference should, on several grounds, be given to conversation.

In the first place, when conversation is employed it is the pupils who determine the degree of depth with which the subject is treated. Suppose, for example, that the teacher has expounded the cause of the seasons and that the pupils have afterwards read about the subject in their text-book, *then the decisive factor is the teacher's and the text-book writer's judgment on what the pupil has an advantage in knowing and is capable of understanding ;* and at the hearing the teacher merely verifies *that the*

desired measure of knowledge and understanding has, in fact, been attained. If a pupil asks a question, it is only so that he may understand all that the teacher or the text-book has communicated to him. It is otherwise if the instruction is given in the form of conversation. The pupils then take their share of speaking throughout the time. *It is then their desire to understand, and again to understand, that sets the limits. The teacher then enters as deeply into the subject as the pupils' capacities permit ; and thus they not only acquire far more thorough knowledge and understanding but come to work their powers at full tension.*

In the next place conversation, without a preliminary " going through " has this advantage, *that the teacher does not deal out a mass of information which is already known to some or even all the pupils.* This kind of repetition is naturally wearisome to the pupils and entirely useless ; indeed it is directly harmful. It prevents the pupils from developing their initiative. But if one enters straight away into a conversation about a subject, one soon finds out whether they know anything about it, and what ; should it happen that they are blankly ignorant, one has but succeeded in making them extremely anxious to listen.

Conversation has the further advantage that it so often provides the teacher with an opportunity to teach the pupils the methods and technique of investigation and thought, and to call attention to the fundamental rules of logic. Naturally a question will often be asked, by the teacher or by a pupil, which the pupils cannot master immediately, not even after much effort ; but instead of answering such questions the teacher ought, as far as possible, *to show the pupils how they can set about finding the answer.* Suppose it is asked, for example : " What

advantage has a narcissus from its petals ? " and suppose no answer forthcoming, one should explain to the pupils that they can find the answer by depriving a narcissus of its petals, or perhaps merely by imagining them absent. By such practice in methodical investigation and thought they not only arrive at a mastery of the concrete problem *but also acquire an eminently important form of skill.*

Lastly, there is yet a psychological factor to be noted, namely *that conversation is a far more natural form of reciprocal communication than the lecture.* Exclamation is the most intensive form of communication ; but exclamation has the form of conversation. In the lecture thought is plantigrade, whether the teacher is expounding or the pupil reproducing. But the moment the brains get properly to work, the desire to break into speech becomes so strong that a long exposition acts inhibitively on the energies ; while contrariwise the brisk interchange of dialogue promotes intensive work.

By this it is of course not meant that the teacher must never discourse continuously nor allow a pupil to speak at some little length ; but this must be something called for by the situation and not the regular practice. To be sure the objection has been raised against class-instruction that it gives the pupils no opportunity for practice in continuous speech, which individual instruction, on the other hand, is supposed to do ; but this contention rests on an illusion and a misunderstanding. It is an illusion to think that a pupil gets real practice in speaking when he is merely reciting a passage learnt by heart or telling again " in his own words " what he has read or heard. Even the greatest readiness of tongue that can be thus achieved is no proof of eloquence. That which is to be good for anything must come from within ; and according to my experience when a pupil has inward

assets of his own he has no difficulty in finding words for them. While the recitals that one hears during individual instruction, when children are reproducing text-book or teacher's lecture, are practically always colourless and impersonal in form, the deliverances of a pupil who is telling of what he has himself seen or thought often exhibit a surprising warmth and freshness of presentation. *If, then, conversation is the method which most powerfully stimulates the pupils' activity as observers and thinkers, it is also that which is to be preferred for the very purpose of exercising the pupils in readiness of speech and true eloquence.* Just as in essay-writing reproduction is in reality a sham and not an exercise by which the pupil learns to express himself, so individual teaching, to the extent that is of a reporting character, is also a form of education that leads to illusory results. But if the individual pupil, coerced, one may say, by the nature of the situation, comes to speak continuously of his own observations or reflections, that is true practice in eloquence. But the necessary condition for this to happen is that conversation is the typical form of instruction.

I can imagine another objection, namely, that the lecture-form makes the pupil more passive and therefore more receptive. But even if passivity is the condition in which the individual is most able and willing to receive, it does not follow that passivity is to last a whole class-hour. It may be that precisely for the sake of the internal quality of the passivity it is advisable that it should alternate with activity. By such a rhythm the pupil's desire for activity and his need of passivity both receive their due regard. Besides, the passivity which is exhibited when *sustained* passivity is demanded is really veiled activity, a quietness which is consciously

willed—from fear or other motives. One must not confuse real listening with the pretence of it. Finally I am somewhat in doubt as to the correctness of the view that preponderant passivity is a necessary condition for receiving deep impressions. It applies in any case only to a moment; for the task of observation generally requires very active mental work on the perceptions and the associations previously formed. It is only when the impressions received call forth strong emotion that the consciousness becomes passive in any pronounced degree —in order to preserve the emotion.

SOME EXAMPLES

As examples of the procedure in conversation where the pupils remained seated, such as were conducted with lively interest in the " United Church Schools," I will give, from notes made immediately after the lessons, the main features in the treatment of the following subjects: (1) The movements of the sea; (2) the size of the earth; (3) radiation of heat between two concave mirrors; (4) the earth's seasons. A desk-conversation on a physical experiment, a plant, or an animal is too difficult to reproduce, since the " object " is indispensable for intelligibility.

In a Class II, the pupils of which are aged 13-14, I came to treat the movements of the sea in consequence of a question from the pupils. First I put the question: " What is an ocean-current ? " and got the class to give a precise definition. When that had been arrived at I asked: " What sets the water flowing in a current ? " and again got the class to try and find the causes of currents, after which I explained in greater detail that winds are the chief cause. That gave the pupils occasion

to ask: (1) " If the wind above the Gulf Stream changes does the current alter its direction ? " (2) " Why does the Gulf Stream divide northward ? " (3) " Does the current go deep like waves ? " (4) " Can the Americans divert the Gulf Stream by a canal through Central America ? " Each of these questions was dealt with by the class or myself answering; after that we studied an atlas-map of the ocean-currents, and then went on to treat wave-motion. With the pupils' casual observations as basis, the class explained that waves arise from a circular movement of the water's separate parts, and with a little help a pupil constructed a " wave " as in the well-known figure of the physicists. After that it was asked: (1) " Why do things drift ashore if the waves do not move forward ? " (2) " How does surf arise ? " And after surf-formation, both on steep and on flat coasts, had been explained with the pupils' co-operation, it was asked: " Can waves which break be formed out in the open sea ? " Thus in the course of an hour these two forms of motion in the sea were treated with relative thoroughness. The pupils were co-operating vigorously all the time; while the pupils' questions and my own continually gave occassion for counter-proofs bearing on the tenability of the explanations given.

In another lesson with a class of similar age, I once treated the measurement of the earth's surface by a series of questions followed by answers and criticisms, in about the following sequence: (1) A pupil suggested that in order to measure the earth's circumference one should travel, say, from Copenhagen to Korsör, measure the length of the journey, and then on a globe examine what proportion the measurement bore to the distance between the corresponding points. (2) By trying mentally to measure a long distance such as that from Copenhagen

to Korsör, the class came to understand that such a measurement would be very inaccurate. (3) A pupil proposed going up in a balloon, sighting two places A and B, and finding their distance by measuring the angle and the height of the balloon above the ground. This suggestion was criticized and rejected. (4) A pupil then proposed raising masts higher than the hills and connecting them by cords at the same height. In the criticism of this proposal it was explained that cords would be useless because they would hang in arcs (clothes-lines). A pupil then proposed taking sights from mast to mast at the same height in order to determine the directions, and then to measure one stretch accurately. Although it is not quite clear what he meant, we had actually arrived at the principle of triangulation, which I thereupon explained. *All the preceding discussion had brought the pupils' minds into a state of readiness to value the knowledge of this method and to understand it.* But if I had started right off by saying : " The earth's circumference is measured in the following way," and gone on to explain triangulation, their attention would hardly have been captured to the extent that it was, nor would they have understood so well. Besides, much is learnt from the criticism of the methods proposed by the pupils ; what is most important of all, *the pupils are all the time full of activity*.

In a Class IV, where the pupils were 10-11, the question of the earth's shape arose one day. The pupils were, of course, aware that the earth is round like a ball ; but they did not know how this can be proved. On my asking for proofs one of them showed he had heard that " one can see it from ships " ; and I then asked whether anyone could explain by a drawing how the earth's form can be seen from ships.

One after another the drawings reproduced in Fig. 12 were produced in the order indicated by the numerals. Each drawing was closely criticized by the class with regard not only to the question of the earth's form, but

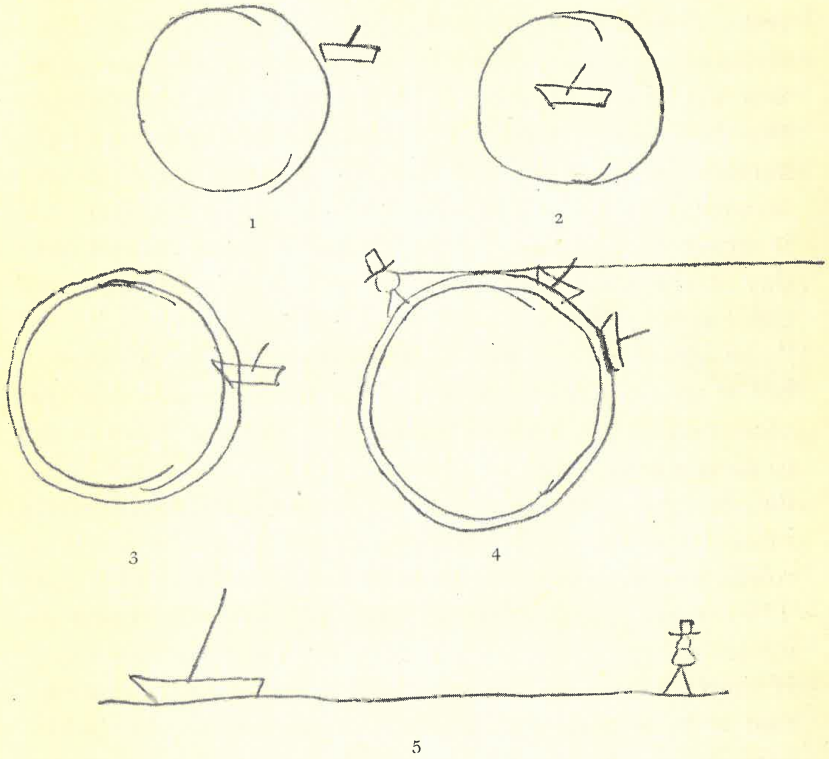

Fig. 12. Drawing in illustration of the earth's form. Drawn by boys of 10-11.

also, e.g., in respect of the ships' positions. When No. 4 had been drawn and approved, No. 5 was drawn as counter-proof ; and it was settled in the course of the conversation what one really sees bearing on the earth's form when a ship is receding or approaching, and how far the probative force of the observations goes. We

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In another lesson with a class of similar age, I once treated the measurement of the earth's surface by a series of questions followed by answers and criticisms, in about the following sequence: (1) A pupil suggested that in order to measure the earth's circumference one should travel, say, from Copenhagen to Korsör, measure the length of the journey, and then on a globe examine what proportion the measurement bore to the distance between the corresponding points. (2) By trying mentally to measure a long distance such as that from Copenhagen

then went on to examine whether similar phenomena can be observed on land, and a pupil remarked that "hills show the rounding." This was more closely examined and illustrated by drawing, and then all understood that plains are also round because "it can be seen from distant things." After that a pupil brought up circumnavigations, and the insufficiency of this proof was explained, together with its historical significance. We then entered on the consideration of the form of the surface bounded by the horizon and its varying area according to the elevation of the observer. After that it struck a pupil that "America and Europe do not have day at the same time," from which it may be seen that the earth is not flat; another bethought himself that "the sun does not rise at the same time in all places, but it would have to do if the earth were flat." In this conversation it thus was made clear to these boys of ten to eleven how it can be observed (1) that the earth is not flat, (2) that it is round, (3) how one cannot legitimately infer from these observations alone that the earth is round everywhere so as to have the roundness of a ball. They came to understand that observations must be made with great accuracy if they are to prove sphericity. If such a subject as this is treated in the ordinary manner, that is by a preliminary lecture from the teacher and a subsequent hearing of the pupils, the result, narrowly examined, is merely that the pupils have been told what they possibly knew beforehand, and have been further humbugged into believing that the main assertion has been satisfactorily demonstrated.

The following account of a lesson on heat-radiation will illustrate in another manner what children can do when the form of instruction gives them opportunity to show their powers. After the pupils had described the

well-known experiment with heat radiating between two concave mirrors—which, be it noted, could not be demonstrated before them—it appeared that they had not thought about the reason why a source of heat at the focus of the one mirror can ignite a body at the focus of the other. But when I asked about this, a pupil worked his way to the idea that the angles of incidence and reflexion of the heat rays must be the decisive factors, and that these must behave in the same way at the two mirrors. I demonstrated this more precisely

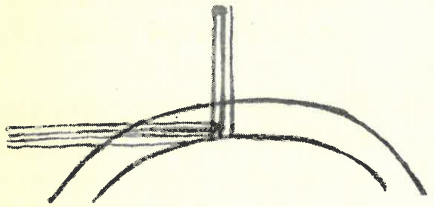

Fig. 13. Drawing in illustration of sun-rays through the atmosphere. Drawn by a boy of 14.

Fig. 14. Drawing illustrating the angle of incidence of sun-rays. Drawn by a boy of 14.

by drawing radii, normals, at the heat-rays' points of incidence. Broadly speaking, the pupils had heard nothing about reflexion or light-rays. We then went on to study the sun, the most important source of radiant heat. To explain how the sun gives more heat the higher it stands, a pupil remarked that "the heat-rays go through most air when the sun stands lowest," and illustrated this by the drawing here given. When I asked if there were not more reasons for the phenomenon, another pupil remarked, after several explanations had been rejected, that the "oblique rays glide away over the earth, but the vertical ones stand still on it." In illustration he drew Fig. 14. When I then asked what it really is that makes vertical rays more heating, a pupil

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gave the perfectly correct explanation by saying: "More vertical rays fall on a piece of ground than oblique ones." This idea was then used to explain why the earth is warmest about the equator and coldest in the polar regions, and so on.

The value of the conversation, as regards the communication and appropriation of knowledge can best be shown by reproducing an essay on "The earth's seasons."

None of the pupils had a book to consult, and they did not know that after the subject had been dealt with I was going to ask them to write an essay on it from memory, the drawings to be taken as text, but each to write and draw as he thought fit.

The course of the conversation will appear from the following series of questions, which I asked, and between which the reader may imagine the pupils' answers and the criticisms of them. (1) What do we mean by seasons? (2) How many seasons have we here in Denmark? (3) How are the seasons different from each other? (4) How is it with the seasons at the equator? (5) What is the number of the seasons in the Sudan? (6) What is the cause of the seasons? (7) To this question there gradually came in answers from the pupils, some right, some wrong, all of which were examined and rejected or approved. For each approved answer a counter-proof was submitted. For example, the significance of the earth's axial inclination of $66\frac{1}{2}°$ was shown by inquiring how the phenomena of the seasons would fare if the axis stood perpendicular to the plane of the orbit, lay in it, or was inclined to it at an angle of $45°$. It was explained in the course of the conversation how it can be known that the inclination is exactly $66\frac{1}{2}°$. After this treatment, which covered perhaps a couple of hours, essays were written. The one now appended

was written by a pupil in the oldest class, corresponding to the leaving-class of the Intermediate School.

THE EARTH'S SEASONS

The natural divisions of the year are called *seasons*. With us (i.e., in our latitudes) there are four seasons: spring, summer, autumn, and winter. The main difference consists in their being unequally warm. Summer is the warmest, winter the coldest, and spring and autumn come between them in the matter of warmth. The higher the sun stands in the sky, the more heat it gives. This is thus the case in summer. In winter, on the other hand, the sun stands low and consequently does not warm much. The other great difference between summer and winter is that the days are unequally long; the shortest day, December 22nd, is about 7 hours, the longest, June 22nd, about 18 hours. On March 21st and September 23rd the day and night are of equal length. But what is the reason of this difference? In few words the reason is that the sun and the earth do not stand still relatively to each other.

The earth turns round itself, and the earth's axis (the imaginary line through the poles) and the axis of rotation coincide. This motion causes day and night. But besides this movement the earth has another; for at the same time that the earth turns on its axis it also revolves round the sun, in an elliptical path, which is, however, very nearly a circle. The sun stands at the focus of the ellipse, and the axis of the earth makes an angle of $66\frac{1}{2}°$ with the plane of the orbit. All this together has the effect that the seasons arise.

Suppose that in Fig. 1 the circle in the middle represents the sun, and the ellipse (at one of whose foci it

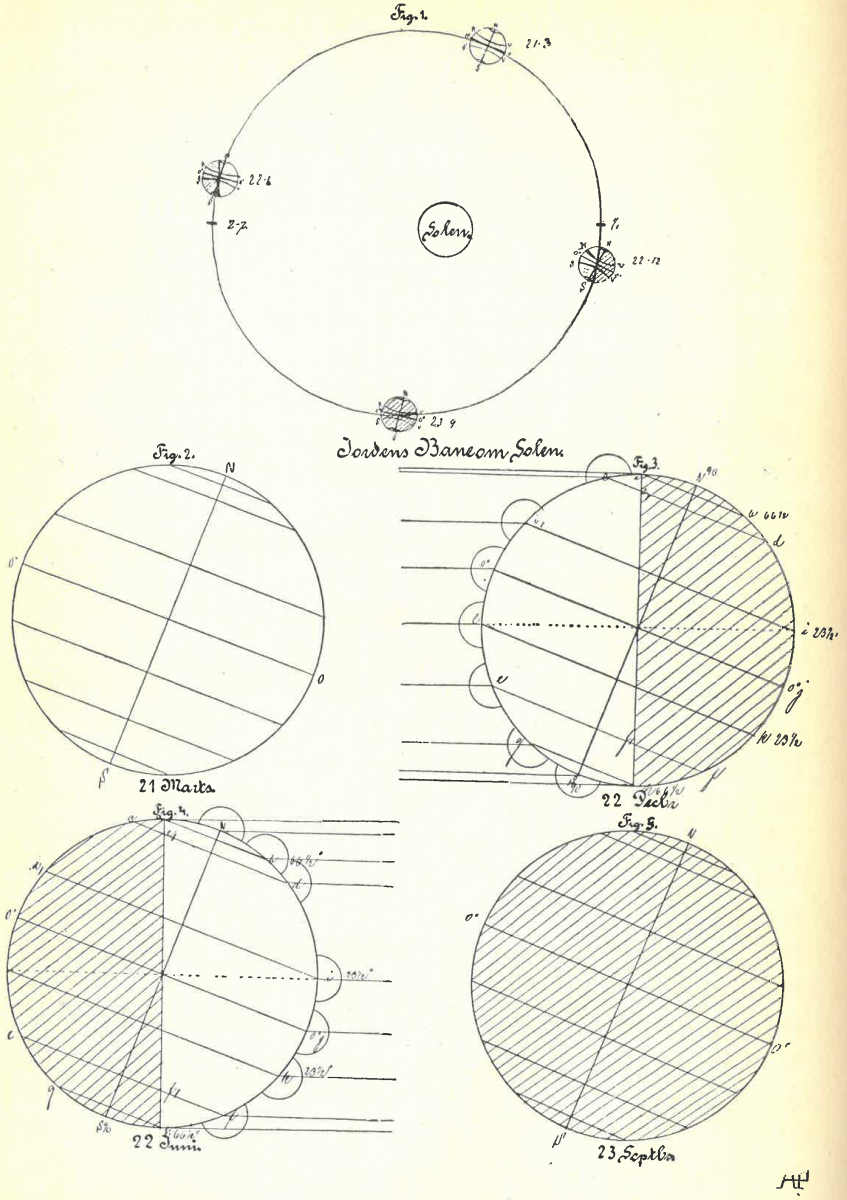

Fig. 15. Drawing in illustration of the earth's seasons. Drawn by a boy of 14.

is placed) the earth's orbit, and the four small circles in this, the earth at four different points of time, then the occurrence of the seasons will be easily understood. The position at the extreme right shows the earth's position on December 22nd, the uppermost one the earth's position on March 21st, that on the left, June 22nd, and the lowest the earth's position on Sept. 23rd.

One sees from this that the earth's axis makes an angle of $66\frac{1}{2}°$ with the earth's orbit, and that it always leans to the same side; in other words, the earth's axis moves parallel to itself in an ellipse.

To understand the occurrence of the seasons we may begin with the earth's position on March 21st (Fig. 2). *NS* is the earth's axis, the lines perpendicular to this different degrees of latitude. The sun's rays are supposed to fall perpendicularly on the paper. The whole of the hemisphere seen in the drawing must therefore be illuminated. One readily perceives that day and night must be equally long, 12 hours each, for the part of each parallel of latitude that is illuminated and the part which is not illuminated are equal to each other. Day and night are thus of equal length; this is called the vernal equinox.

A quarter of a year later, on June 22nd the situation is no longer the same. One sees, from Fig. 4, that when the earth turns on its axis that part of the earth which lies north of the line *ab* will have no night but continual day: *ab*, the boundary of this part of the earth, is called the north polar circle. South of the polar circle there will not be daylight for the whole of the 24 hours, but still for the greater part of it, and the night will be very short. At a place lying on the parallel *cd*, the day will be $2c_1d$, the night only $2cc_1$. The further south one goes the more the length of the day approaches to that of the night, and on the equator they are equally long.

South of the equator the relation is reversed. A place on the parallel *ef* will have a day which is only $2f_1f$ and a night which is $2ef_1$. South of the line *gh* there will be night for the whole 24 hours. The line *gh* is called the south polar circle. If the small semicircles placed at *N*, *b*, *d*, *i*, *j*, *k* and *f* represent the visible vault of the heavens, one can see how high the sun stands in the sky. At *N* the angle is least, and the sun here circles round the sky. The further south one goes the higher the sun stands in the sky, and for all places north of the point *i* the sun stands as high as it can. At *i* it stands perpendicular (at the zenith); but north of *i* it can never be perpendicular. The boundary for this, i_1i, is called the tropic of Cancer. South of this the sun stands as low as it can on the parallel concerned and south of the south polar circle it cannot be seen. The northern hemisphere thus has summer: the days are as long as they *can* be, and the sun stands as high as it *can* stand. The southern hemisphere, on the other hand, has winter: days as short as they *can* be, and sun as low in the sky as it *can* stand. As in the northern hemisphere the sun does not go very far below the horizon, a part of its light is refracted, and "the bright nights" result.

A quarter of a year later the autumnal equinox (September 23) occurs, and day and night are equally long all over the earth, precisely as on March 21 (Fig. 5).

A quarter of a year after this the position of the earth is the opposite of what it was on June 22 (Fig. 3). Now it is the southern hemisphere that has summer and the northern that has winter. The south polar regions have continual day. The north polar regions have continual night. At this time the sun is vertical over the parallel *lk*; this is called the tropic of Capricorn. It is readily

seen that the tropics lie respectively $23\frac{1}{2}°$ north and $23\frac{1}{2}°$ south of the equator, and the polar circles respectively $66\frac{1}{2}°$ north and $66\frac{1}{2}°$ south of the equator. There is, however, a remarkable fact about the length of the seasons in the northern and the southern hemispheres. It appears that in the northern hemisphere summer is longer than winter, in the southern conversely.

Summer in the northern hemisphere lasts:

from March 21 to April 1 . .	10
April	30
May	31
June	30
July	31
August	31
September 1-23 . .	23
	186 days

Winter is therefore 365 — 186 days, and summer is thus a week longer than winter. In virtue of the physical law that the velocity diminishes proportionally with the square of the distance, the earth does not move with uniform speed as the distance from the sun is not constant. On January 1 it is least and the earth moves rapidly. Half a year later, on July 2, it is greatest, and the earth moves more slowly. This is the reason that summer lasts longer, namely that the earth does not hurry; but in winter, when it is near the sun, it moves quickly, and winter does not last so long in the northern hemisphere.

But how are we able to prove all this?

That the earth moves round the sun may be observed through a telescope in this way. The telescope is pointed at a particular star on December 22, and then on June 22 the star cannot be seen unless the telescope is

slightly readjusted ; for the line of vision is not the same on the two days. It thus turns out to be correct that the earth moves round the sun. That the path is an ellipse may be seen from the fact that the apparent size of the sun is not the same on January 1 and July 2, for the sun is not equally distant. In January it is larger than in July. That the earth's axis makes an angle of $66\frac{1}{2}°$ with the plane of the orbit may be ascertained by calculating the latitude of i on June 22. This proves to be $23\frac{1}{2}°$, consequently the angle between i and j is $23\frac{1}{2}°$, hence the angle between d and N is also $23\frac{1}{2}°$, and between N and i $90°-23\frac{1}{2}°=66\frac{1}{2}°$. All the rest are simple consequences of this.

That the position of the axis has importance may be seen by reflecting that if it were perpendicular to the plane the seasons would not occur, and if it lay in the plane then, by turns, the one hemisphere would have day and the other night.

Two other samples of the results of class conversations are given in the accompanying drawings in illustration of the moon's phases. The pupils drew nothing during the lesson, and they did not know that I was going to ask them to draw the phenomenon at home.

PUPILS' QUESTIONS

As class-instruction, even when it is merely the hearing of a lesson, but more particularly, of course, when it approaches to or actually is conversation, gives occasion for the pupils to put a large number of questions, I have in the course of years had rich opportunity to collect a mass of material which records and illustrates the interrogators' interests and general mental condition. For the sake of the collection I have for several years had a pupil

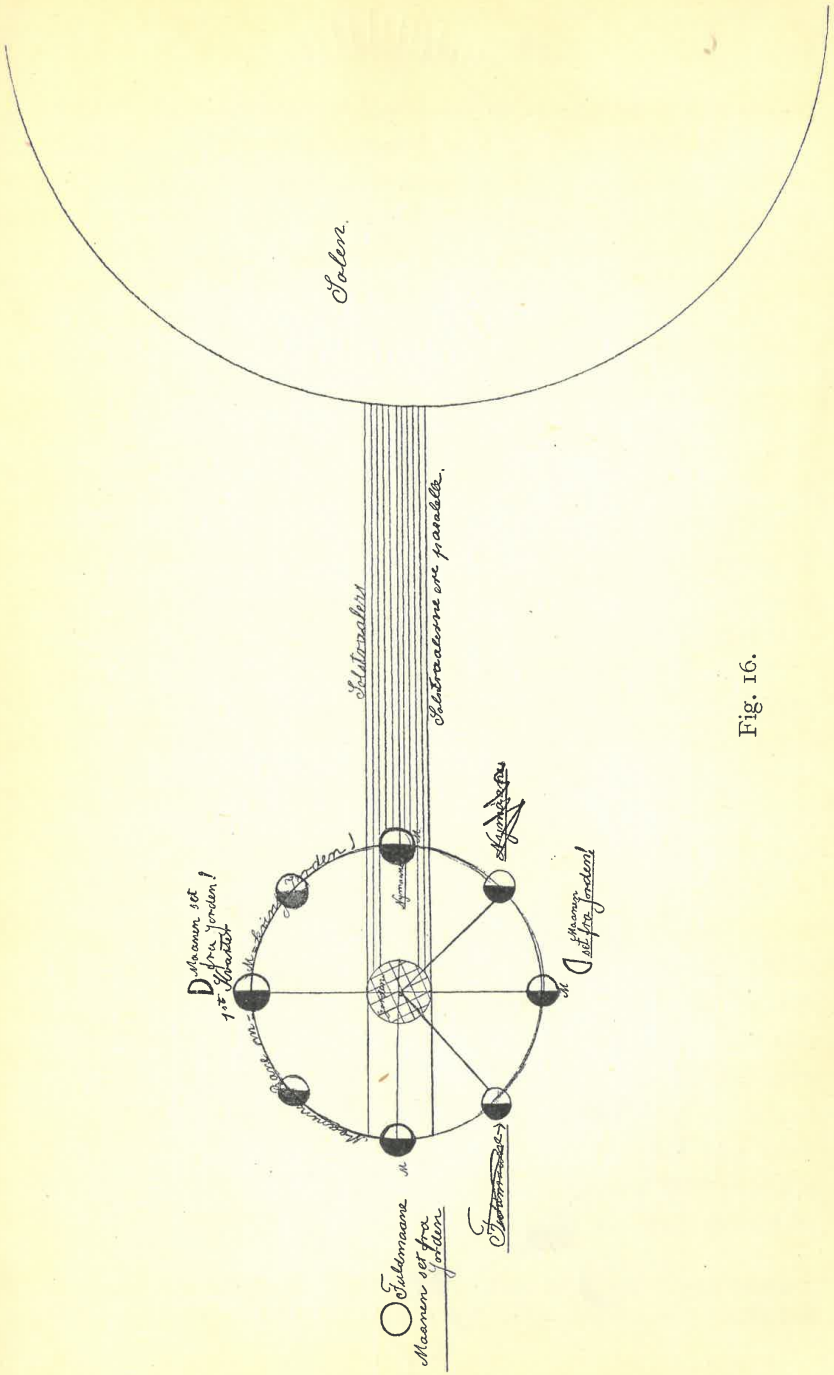

Fig. 16.

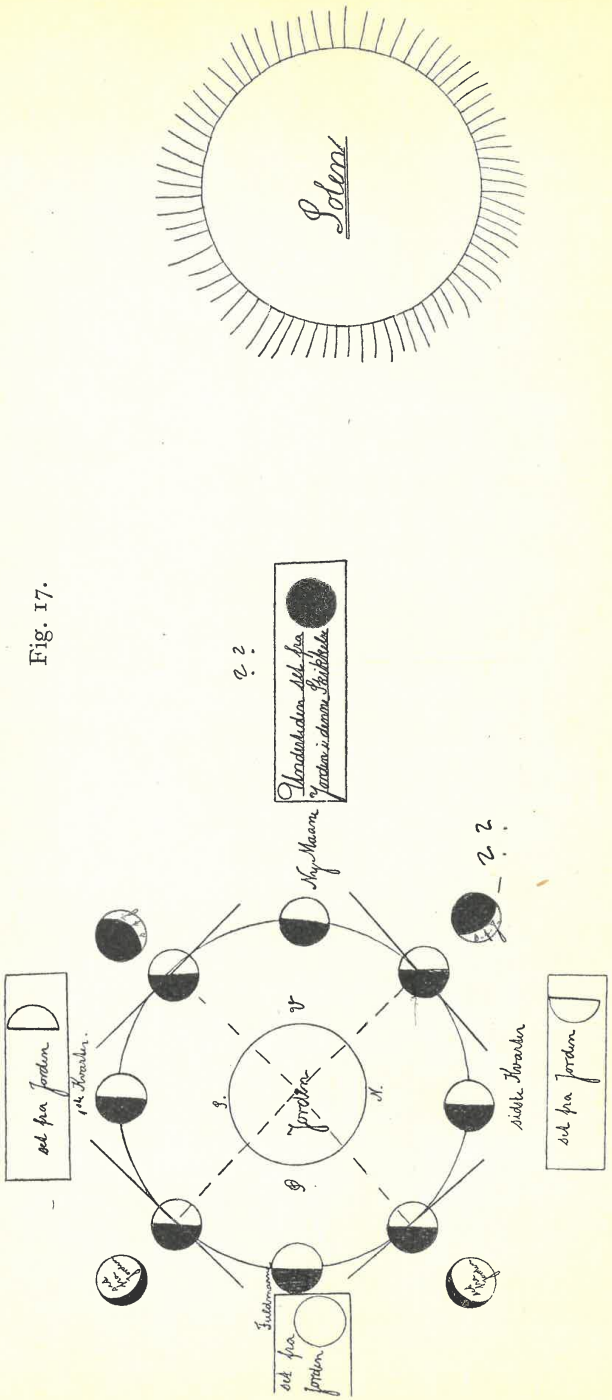

Fig. 17.

in each class keeping a day-book in which he wrote down those questions that seemed to him of special interest; and I have myself made numerous entries in my diaries. From both these sources I shall now quote examples of various kinds of questions. After each the number of the class is added in brackets.

I.—GENERAL KNOWLEDGE QUESTIONS

Most of the questions, as may well be imagined, aim merely at getting knowledge about something or other that has cropped up during the treatment of a subject; they may be called acquisitive questions. As types I cite the following, which, in my judgment, have been the most interesting because they provided natural starting-points for good conversations.

What is the cause of the blood being able to circulate in the body?—Why is the north pole on the globe kept up and the south pole down?—The world was a great sea in the beginning: how did there come to be fresh and salt water?—How can the wind move?—What has peat come from?—What does equator mean?—What was wrong with the lunatic king, Christian VII; what made him a lunatic?*—How is it that nearly all birds are lighter-coloured on the belly than on the back? (IV).

How can the ashes of a volcano force a hole into the crater?—How does one know that it is so hot in the lava in a crater?—What does lava consist of?—Why is it hot in the earth's interior?—How far down can the lava be?—How can one have sunstroke?—How has marble come into existence?—Why are there no volcanoes in

* The history teacher had hinted that it was a "bad habit," masturbation, that had made Christian VII a lunatic, but would not give information about it.

Norway ?—How does the great heat manage to get down into the earth ?—Can the worm get air down in the earth ?—When the spider has used its poison does it get some more ?—Why does the shark's tail bend upwards ?—How can we see with our eyes ?—What is fog ? —Why does the blood not freeze in the winter like water ? —How can one lose one's wits ?—How can one weep ? —What is the reason that one gets tired ?—What is imagination ?—How did the earth come to be ?—Have all male cockchafers the same number of points in the comb over their feelers ?—Why is it called " the Red Sea ? "—Why does the earth turn on its axis ?—How does it come that children are like their parents ?—Why do the stars not shine by day ?—How could the first men understand each other ?—Why are there men ?—Why is there anything alive ?—Why are there so few fruits from a chestnut-top, seeing there are so many flowers ? —How did the proteus get into the caves ?—Why are the Americans so good at inventing ? (III).

When one dreams about England is what one dreams correct ?—What will happen to the organisms when the earth cools ?—How can the sun be eclipsed ?—Why is it cold on the mountains at the equator ?—Do clouds really go as fast as their shadows ?—Sometimes clouds move across the sky in opposite directions ; why is that ?— How is it one gets so hot in the hand when one walks holding a bouquet in one's hand ?—Why does water form small drops when one pours it out on a dusty road ? —How is it they don't notice they have their heads downward on the other side of the earth ? (II).

Where does the water on Mars come from ?—Can there be men on Jupiter ?—Can heat travel by conduction through an empty space ?—Why do people believe that birds and mammals are descended from reptiles ?—

How is it molecules vibrate rapidly in heat and slowly in cold ?—What keeps the stars in their orbits ?—What are the " leaves " on a cactus ?—How is it one sometimes sees light when one shuts one's eyes ? (I).

2.—DOUBT AND CRITICISM

Far more interesting than the questions which mainly or exclusively aim at increasing the stock of knowledge are those which express the pupils' doubt and criticism. Naturally it may be difficult to decide, in the particular case, whether a question belongs to the one category or the other. But generally the situation of the moment has made it clear whether there was in the remark that tinge of aggressiveness which is found in an expression of doubt or direct, overt criticism.

With this reservation, that the boundary between the types of question is a fluctuating one, I will give some examples of expressions of doubt or criticism, here and there accompanied by a little explanation.

How do we know that it is 850 (Danish) miles to the earth's centre ?—Once when I had thoughtlessly remarked, in connection with a question regarding the decrease in the number of frogs, that lakes are not now drained to the same extent as formerly, but used for artificial fish-breeding, so that the fresh-water area is not diminished, a boy said : If the lakes become ponds for artificial fish-breeding, frogs cannot live in them.—They say that heat increases inwards towards the earth's centre, but in physics we have learnt that heat rises* (I Intermediate).

* The fact that there is here a misunderstanding of the words of the physics teacher does not affect the question of the pupils' expression of criticism.

If one places a thermometer in the bell of an air-pump and pumps out the air, will it not then show a low temperature; for it is the air (outside the thermometer) that has the heat?—Will there not be too many pariahs in India if criminals are expelled from their castes and their descendants become pariahs?—How do we know that the extinct three-toed "horses" were horses and not tapirs or rhinoceroses?—Why do the tame animals so often have pendulous ears? Someone here answers that it is because they have not the need in hearing well. But then another asks: But why, then, has the tame pig bigger ears than the wild pig?—Why does the moon not fall on the earth (seeing the latter exercises attraction over it)?—Why is it not as warm on the mountains as on the low-lying land, seeing the sun shines on the mountains as well?—When you drop a thing it falls because you drop it, not because of its weight.—Does the earth attract all things equally strongly?—The earth does not need the sun's heat, because when it turns on its axis it gets warm like a man running.—Why has not the moon the same colour as the sun, it gets its light from it?—Why does not the earth shine when the sunlight falls on it?—When an Australian dreams he has killed an animal, does he also send his wife out for it? (II).

Why do not colours arise from the refraction of light in a lens as well as in a prism?—How do the white rays of the sun really turn into red, yellow, etc., by going through a prism?—If the sun turns on its axis is it not flattened? (No.) Then how can the earth's turning on its axis be the cause of its being flattened?—How can one know that the earth turns from West to East and not the reverse?—How can we know that the earth's axis in the picture (illustrating the seasons) ought to lean to the right?—When there are volcanic eruptions on the

moon it cannot be just water that causes the eruption, for there is no water on the moon.—How can one really know that a volcano is extinct?—When lead and wood fall in a vacuum which of them is it that falls differently from in air?—How can one know that the fruit of the horse-chestnut originally had three seeds? It might just as well be that it is on the way to have three seeds.—Why does it not get cold below when the warm air rises?—If air is a bad conductor of heat, one need not put ice into straw so that it may not melt.—How is it that in a picture at the exhibition Eve is painted with a navel, seeing she was not born of anyone? (I).

A peculiar position is occupied by criticism dealing directly with the instruction, and I will therefore cite a few examples and say something on the useful effects of such criticism.

One day, after a class had had an hour's lesson on beetles, a boy said, in a very polite and amiable manner: "It was so boring to-day, Mr. Rasmussen; there was not one amusing word." Naturally this was not very encouraging for me, and I could not understand why that hour should have been so tedious. The pupils had apparently been very interested. They had looked at three cases of beetles, partly Danish, partly Brazilian. I had been under the illusion that the subject had fully interested them; but when I asked others if they had been bored they answered affirmatively. What the reason was, no one could say. But on closer consideration I found an explanation, and negative tests have shown that it was right, though possibly not exhaustive. During the preceding study of the vertebrates the pupils had become accustomed to thorough, direct observation of the individual animal. They now had presented for their inspection a couple of hundred beetles all at once, and

careful examination of the individual beetle was an impossibility. They could only get a superficial impression of colours and forms. It was this compulsory superficiality that was the reason. When, therefore, I undertook the charge, right from the start, of a new collection for the Intermediate School classes, I dispersed the insect collection in the small boxes formerly mentioned, so that each pupil could have for observation his own box with quite a few animals in it ; and the consequence has been that the pupils draw and write essays about insects with the greatest keenness, and find it entertaining even now after the lapse of a year. My pupil's critical remark has thus had extraordinary value for my method of instruction.

Once when I was teaching a class about the camera obscura and told them that the form of the image is independent of the form of the aperture, some of the pupils declared that they found this impossible. As I did not immediately think of proving the fact by experiment, e.g., by gumming a piece of paper with an irregular hole in it over the lens of the camera I had at hand, I said that, of course, everyone might believe what he liked. Some days later a boy told me during a lesson that he had experimented in an attic and there seen a round image of the sun made by a polygonal hole. In this case, therefore, my recognition of criticism led to a pupil's initiative and spirit of inquiry being set in motion.

On another occasion the following incident happened. In the course of several lessons I had been showing experiments illustrating the properties of oxygen, hydrogen, nitrogen, carbonic acid, etc. But when the first astonishment at the experiments had subsided, one of the boys asked one day : " What does chemistry really signify ? " i.e., What is all this hocus-pocus at bottom ?

If the pupils had themselves performed the experiments, the question would perhaps not have come so early ; but it would, all the same, have been raised sooner or later. The subject, in fact, had been attacked in the wrong way. The pupils could not co-ordinate the new matter with the mental stock already in their possession. So I set about investigating by means of conversations, and got the pupils themselves to point out a large number of examples, taken from daily life, of the application of chemistry ; and I added a little about what might be expected in the future from the development of that science ; and thus real, conscious interest was secured for the experiments which followed. The criticism thus helped me to discover a way of improving my procedure, and gained for the pupils increased profit from the instruction.

At another time a difficult situation arose. I had been led by questions from the pupils to expound a little elementary astronomy and had spoken, among other things, about the distances and magnitudes found in the universe. With this I came to the final result that space is infinite ; but then a boy broke in with the question : " What's the use of knowing that the universe is infinite ? " Again I had been caught in an illusion ; for it had not occurred to me that my deliverances had been above the heads of my pupils, and all the time they had listened devoutly and put questions keenly. But starting with this pupil's question there developed a searching conversation on the conception of the world which individuals carry about with them, and from this we passed on to recognize the value of the inquiring type of mind both for the welfare of the individual and for the progress of mankind considered in relation to welfare. Thus not only were the astronomical facts

worked into the pupils' stock of ideas, but they gained the far more important benefit of having the importance of inquiry and investigation brought home to them in a manner that touched them personally.

3.—THE GROWTH OF IMAGINATION

Another property of the conversation-method is that in a far higher degree than other methods of oral instruction it relaxes the mental constriction of the pupils, rouses their inventiveness, gives them ideas, makes them unleash their imagination, generally promotes the positive side of thought in its freer forms. For closer illustration I will quote the following questions :

Perhaps the cuckoo first lays its egg and then finds a nest where the eggs are the same colour as the cuckoo-egg.—If men are descended from animals, where have the noble families come from ? (IV).

Will not the organisms be able to endure more and more cold as the earth gets colder ?—May we not suppose that new organisms will arise which will be able to stand lower temperatures than those of to-day ?—Has the plane of the Po once been sea ?—Can't one get the eggs of the proteus turned into salamander-eggs ? (III).

Will not England conquer all Africa (seeing she has taken so much) ?—When one is up in a balloon, cannot one see that the earth is turning round ?—May not the horse's rudimentary metacarpals disappear entirely ? —Have amœbæ and infusoria absolutely no reason ? —May it not be supposed that Saturn's rings consist of globes going round so quickly that one can't see them separately ?—They say the sun has developed in the course of time, like a little child ; according to that, one would think that it also must some day die or go out.

—One day when I spoke of Eve's " homunculi " a pupil asked : " Yes, but when Eve's homunculi are all used up, what then ? " One of the consequences of the theory is, indeed, precisely this, that mankind must die out (II).

Does not an eclipse of the moon arise from the moon being seen through the earth's central shadow, just as the sun looks darker than otherwise when seen through a smoked glass ?—Is it possible that lava dissolves some of the stones in the crater-walls, so that the lava of volcanoes is different for that reason ?—May it not be pressure from the earth's crust, caused by contractions, that forces lava up ?—Is it not possible that the side-line of fishes is a sense-organ, that plays a part in the business of mating ?—Has mankind always been as modest as now ? (I).

4.—SEXUAL MATTERS

The last question cited touches on a side of life which is well served by teaching of the conversational type, namely, questions relating to sex. To inquire how far these matters may rightly be treated in a school containing pupils of from ten to fifteen would here lead too far.* I assume, therefore, that such treatment is legitimate, and ever since I began work as teacher in 1890 I have made the subject a theme for discussion. No former pupil has ever supplied me with evidence of any harm resulting from it ; on the contrary, many have borne witness both orally and in letters to the profit which they have derived from the knowledge. A boy of fourteen, while still attending school, wrote in a letter : " You also told us something (about masturbation) which I believe has been very useful to the whole class ; "

* See Vilhelm Rasmussen : " The Intermediate School Child."

and another pupil wrote : " The question (masturbation) which you have several times discussed with us has had a great effect on us ; in my case it has been very profitable ; for we are now at the age when that sort of thing begins to press a little. . . ." A former pupil writes in a letter : " Your fearlessness in discussing the most delicate subjects with us boys has always appealed to me. Like many of my companions I was a victim of onanism, but when you spoke of the ' much-discussed question ' I kept up an air of seriousness and made as though I were fully in agreement with you (i.e., as if there was nothing wrong with me) and yet I could not abstain from it or keep my thoughts from busying themselves with various sexual images. . . . Well, it is a matter that I fortunately got clear of by myself, but it was difficult."

When I ask whether anyone has been made uncomfortable by such questions being spoken of no one has ever come forward, neither in classes of boys nor of girls ; and in virtue of the general atmosphere, the free relations between the pupils and myself, those who had felt uncomfortable would certainly have said so.

Originally I treated matters pertaining to this field in the same way as the rest of natural history, by telling the pupils what I thought useful. At that stage, therefore, the treatment was superficial. The pupils asked practically no questions. The guiding factor was not *their* desire to know but *my* conjectures as to their needs. When I lighted on the conversational method the whole treatment took on a quite different character. It became thorough, relatively exhaustive, in that whenever subjects of this sort came up I allowed the pupils to ask themselves dry. The result is, partly that I tell them nothing which, at the moment, is unnecessary knowledge, and partly that full, candid information is

given on all that the children's curiosity or genuine thirst for knowledge causes them to ask about.

In order to understand how precisely the questions given below came to be asked, it must be remembered that the pupils are Copenhagen children, who read low-class papers ; and that they are poor children from small flats, which has the consequence that from their parents' lives they learn much that is unknown to children from higher-class homes. Even at a very early age children learn more than people commonly suppose. A girl of about five threw her arms one morning round her mother's neck, and asked : " What really was it you and father were doing last night ? "

In each class all the main divisions of the subject come up for discussion during the course of the years, especially onanism, fecundation, birth, and venereal diseases, occasion being supplied by Bible-history (circumcision), history (Christian VII), literature (expressions in Holberg), newspapers, or the phenomena of natural history. On the matter of onanism I deliberately seek to call forth questions when a subject having links with it is treated for the first time.

The boys, so far as I can remember, have always asked orally. In the case of the girls, whose ages were from thirteen to fifteen, I have eased the putting of questions by allowing them to be submitted in writing. Each sex has been taught by itself.

1. What is the meaning of castrating animals ? (experiences of a stay in the country). Where are the seminal glands ? What is the French disease ? (III).

2. How does man come into being ? Why are there both men and women ; there might well have been only one kind of human being ? When it says in the Bible : " In thy seed shall all the nations of the earth be blessed,"

is it man's semen that is meant ? (The religious teacher would not tell us.) What is onanism really ? (III).

3. How can a woman have children when she is not married ? What is circumcision ? How is semen produced ? How old must a woman be to bear children ? What is concealment of birth ? Is a woman ill when about to bear a child ? What is onanism really ? (III).

4. What do twins come from ? How long is a woman pregnant ? What is the womb ? How long does a birth last ? What are venereal diseases ? What is immorality ? (I).

5. What is abortion ? What is a prostitute ? Can a woman have children after her husband's death ? How long can a cohabitation last ? Does it hurt the man to discharge semen ? What is a woman's virginity ? (Holberg). A boy said during this lesson : " We know much more than our parents think, and we think about it more than they dream of " (I).

6. Where does the blood come from that is lost by a person during menstruation ? Is it hurtful to have children ? What is it causes a child to be stillborn ? Can onanism act hurtfully ? How can that vice arise and how can it be got rid of (I, girls).

From the examples here adduced it appears among other things that the whole sexual domain is much less mysterious for children than is generally supposed. It is the adult, who, by his reticence on these matters, creates for them an atmosphere of mysticism and embarrassment. The children themselves are practically wholesome-minded and quickly become familiar with the idea that sexual matters are just as natural as the facts about digestion or bathing.

That children have a naturally healthy attitude towards the subjects here in question may also be seen from the

manner in which they occasionally mention in their essays observations bearing on sex, as will now be illustrated by a few quotations : " When I was in the country I saw a cow calving. First came two white lumps ; they were the hoofs of the forelegs. The man came up, and I fetched a rope, which we tied round the feet, and then the man pulled with all his might. So at last the grey nose came, and the ears lay along the back. When the head and the front part of the body had come out, the hindquarters and the hind legs slipped out of themselves ; but the after-birth still hung back. This came away a day or two later . . ." (age $11\frac{1}{2}$).—" When the puppies were just born they had a slimy coating on them, but the mother got hold of the navel-string and shook them out of it, and after that she bit across the navel-string so that a short piece was left hanging " (age 13).—" Before the queen can lay eggs she must be fecundated by the males " (age 13, girl).

In the classes of the Intermediate School, where there was common instruction for boys and girls, it was, of course, impossible to employ the same method as in the separate classes of the " United Church Schools," but by aid of the presentation of the subject in my " Zoology Text-books for Intermediate Schools " the pupils obtained full information in another way. The principle I have followed in my books is that of giving the necessary information dropwise, beginning with fecundation in the jellyfish, after which the teacher at suitable passages, e.g., bearing on fishes, may mention similar facts. In my " Biology for ' Real ' Classes " I have given an ample account of fecundation and individual development ; and I have never noticed that the pupils took any offence at these subjects being mentioned. In a collection of letters from a " real " class concerning my instruction

in biology there is only one in which it is said that biology is a subject which should not be taught in a mixed school because " one can speak with less constraint about various things " in separate classes ; but this is really an indirectly-expressed wish for more thorough knowledge. Two writers of letters say that the chapter on fecundation is specially attractive. A girl writes, among other things : " From biology I have learnt to look naturally at all the things that happen in nature ; by this I mean especially what many people always want to whisper about, even if it is mentioned on the right occasion, namely, the first development of the human being." A girl from another " real " class wrote in her letter : " Most instructive are the parts about fecundation, the development of the individual, etc."

The observations here reported concerning class-instruction, especially in conversational form, prove that for the pupils it brings great attentiveness, wealth of ideas, powerful play of imagination, that it makes them conscious doubters and critics, trains them in correct and methodical thinking, that it shows the teacher how far the pupils can attain, and has for effect that the subjects are treated with relative thoroughness.

Individual instruction in conjunction with the teacher's discourse or lecture has far from the same valuable results. The teacher's lecture controls the course of thought ; and therefore the pupil's initiative does not get a start. If the pupil is consistently attentive and receptive, he is weaned from independent thought and the edge of his critical faculty is dulled. If doubt or conscious criticism is roused, he cannot put them into words without injury to the character of the lecture. The lecture represses independence. The lecture elicits only assent, the conversation dissent as well.

CHAPTER VI

" SYSTEM " IN INSTRUCTION

A natural consequence of the pupils becoming first-hand investigators, though in a childish way, is that " System " is taught in quite a different manner from what is customary.

When I received my first instruction in natural history, I used, both in zoology and in botany, text-books in which the system played a dominant part. Quite naturally, therefore, when I became a teacher myself I laid at the outset quite too much weight on the system ; I let my pupils learn the common characteristics of all carnivora before making the acquaintance of any one carnivorous animal, of all the leguminous plants before they rightly knew a pea. But as soon as my eyes were opened to the significance of observation I understood that the system, in its traditional form, was the feature which I must first remove from my instruction.

It may be objected to this that a " species " or a " genus " is just as much a collective idea as a " family " or order, and that it is therefore just as legitimate to begin by talking about what is common to an order or a family as to begin with genus or species. And as it is undeniably possible to communicate a greater quantity of matter if one bases one's description on the large groups than if one begins with the lowest, the species or the genus, one might think that the " systematic method "

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was the best adapted to its purpose. But the question cannot be decided by such abstract logic. It must be remembered that in various ways daily life teaches children a certain amount of natural history, so that they come to school with a stock of established ideas to which school must in part bow. This is the case, particularly, when the school has to choose whether it will regard a zoological or botanical order, family, genus, or species as a " type." Here the actualities of daily life must have a share in the decision. But now everyone, for example, distinguishes sharply between beech, oak, alder, and other catkin-bearing trees, and does not think of any of the trees named as a catkin-bearer. A beech is a beech, i.e., a type by itself. In a similar way daily life distinguishes the fox from the ermine, and does not apprehend them as carnivora. Well, then, the school must also allow its pupils to begin their natural history investigations with the beech, the oak, the alder, the fox, and the ermine as " types," and allow them to discover that there are certain features common to these plants or animals which make it *possible* for each of them to be regarded as a joint-type of a higher unity.

The necessity of sometimes taking as type the species, e.g., fox, ermine, sometimes the genus, e.g., oak, alder, sometimes the family, e.g., ground-beetle, capricorn, is not the fault of daily life and still less of the school, but has valid reasons of its own which must be respected. If one does so, the pupils will always feel themselves facing the individual and the comprehensible; and while they cannot on the basis of their previous experience discourse or rightly understand discourse about carnivora or leguminous plants, they will fearlessly tackle the fox and the pea.

But of course it is not necessary to ignore the system

entirely because one *begins* with the types of daily life. The system has its own high importance since it provides a comprehensive view and greatly assists the memory. The main point, therefore, is merely that one should not *begin* but *end* with the system. Besides, one should see to it *that the pupils form their system as far as possible from the experience they have of the individual types ;* for then they not only have the system but become accustomed to systematize for themselves, i.e., to introduce order into a multiplicity of impressions. This " habit " is more important than the knowledge of sundry systems.

In concordance with this view my text-books contain no remarks about the system. The animals are merely named in systematic order. Therefore, the teacher, if he wishes, *may in the lowest classes take fresh-water animals, the animals of the field, the animals of the forest, the animals of the sea, and so on*, and then later take the matter in a different order, e.g., according to affinity. When then the pupils have acquired enough knowledge and have become old enough, one may begin to let them systematize for themselves, i.e., find likenesses and differences between animals. One will then discover that they can achieve a good deal in this direction, although the book gives them no guiding hint. In order to illustrate this more precisely I append some tables, constructed by my pupils, Sometimes I get them to make the table at home, quite by themselves ; at other times I tell them that in the next lesson I will converse with them on the points of likeness and difference between such and such animals. The first kind of synopsis always betrays itself by some naïve but very interesting remark, as will be seen from A, which was compiled by a boy of eleven in the " United Church Schools."

A.—LIKENESS.

Bird.	*Mammal.*
A creature.	A creature.
alive.	alive.
breathes with lungs.	breathes with lungs.
male and female.	male and female.
must have food.	must have food.
evacuation.	evacuation.
loves its offspring.	loves its offspring.
knows man from animals.	knows man from animals.
can move.	can move.
1 head.	1 head.
2 eyes.	2 eyes.
1 brain.	1 brain.
1 tongue.	1 tongue.
1 neck.	1 neck.
2 ears.	2 ears.
legs.	legs.
1 heart.	1 heart.
2 lungs.	2 lungs.
1 stomach.	1 stomach
feeling.	feeling.
has intestines.	has intestines.
must die.	must die.

DIFFERENCE.

Bird.	*Mammal.*
is hatched from an egg.	is born of its mother.
lays eggs.	brings forth living young.
does not suckle its young.	suckles its young.
covered with feathers.	covered with hair.
invisible ears.	visible ears.
no teeth.	has teeth.
has a beak.	has a mouth.

Bird.	*Mammal.*
2 wings, 2 legs.	4 legs, no wings.
can fly.	cannot fly.
a tail of feathers.	a tail of bone, flesh and hair.
has no hair on its legs.	has hair on its legs.
feathers can be used for pillows and ornament.	hair cannot be used for pillows and ornament.

The "United Church Schools," Class IV, 1898.

The other synopses given, which were written after a class-conversation, are so far defective that they do not reveal the pupils' naïve ideas; but these were not lacking, they simply came out in the conversation and were criticized either by the class or by myself. B and C were written by girls of about eleven in a higher girls' school here. I give them both, although they deal with the same subject, in order to show how well the pupils remember the work of the lesson-hour. During the hour itself nothing is written down. D and E are synopses written a year later by pupils of the same class. F is the result of a thirteen-year-old class's work in the "United Church Schools," and G, H, I and J are by pupils in the leaving-class (aged about fourteen) of the same school.

During the conversation I may sometimes interject a remark or two when the pupils stick fast. At the beginning of the hour they work as a rule from memory only, but when a shortage of new ideas sets in they are allowed to use the pictures of the text-books.

B.

Birds.	*Mammals.*
Feathers.	—
Eggs.	—
Beak.	—

Birds.	*Mammals.*
Tail of feathers.	—
—	Teeth.
Hind-toe.	—
—	Young suck their mother.
Nostrils at base of beak.	Nostrils on the muzzle.
Birds have wings.	—
—	ear-lobes.
two legs.	four legs.
steer with their tail.	—
long leg.	short metatarsus.
scales on the legs.	—
—	milk.

C.—Difference between Birds and Mammals.

Birds.	*Mammals.*
Have wings.	—
Lay eggs.	Bring forth young.
Can steer with their tail.	—
Tail is of feathers.	Tail is of flesh and bone.
Has a hind-toe.	—
Beak.	Teeth.
Has longer toes.	Has shorter toes.
—	Has ear-lobes.
Has feathers and down.	Has hair.
Eyelids close from down up.	Eyelids close from up down.
Nostrils are at the beginning of the beak.	Nostrils are on the muzzle.
Can fly.	—
—	Young suck from their mother.
Has a long metatarsal.	Has a short metatarsal.
Can see far with its eyes.	—
Has two legs.	Has four legs.
It hatches its eggs.	—

D.—The Animal World.

Salamanders.	*Frogs.*
Fixed thick tongue.	Loose tongue.
Crest on back.	—
Tail.	—
—	Web between hind toes.
Long body.	Short body.
Swim with their tails.	Swim with hind toes.
Short hind legs.	Very long hind legs.
Invisible ear-drum.	Visible ear-drum.
Young get forelegs first.	Young get hind legs first.
Young are like the old in bodily form.	Young are not like the old in bodily form.
Eggs laid each by itself.	Eggs laid several together.
Young do not change greatly.	Young change greatly.
—	Can jump.
Males are larger and handsomer than females.	—
Young live on small animals.	Young live on soft parts of plants.
Hind toes short.	Hind toes are long.
Eyes not outstanding.	Outstanding eyes.
—	Can croak.

E.

Salamanders.	*Frogs.*
Fixed tongue.	Loose tongue.
Crest on back.	—
—	Web between hind toes.
Long body.	Short body.
Swim with the tail.	Swim with the hind legs.
Short hind legs.	Very long hind legs.
Invisible ear-drum.	Visible ear-drum.

Salamanders.	*Frogs.*
Young get forelegs first.	Young get hind legs first.
Young are like the old in bodily form.	Young are not like the old in bodily form.
Eggs laid each by itself.	Eggs laid in collection.

F.—Difference Between.

Insects.	Spider.	Millipede.	Crab.
Composite eyes	Simple eyes	Both	Composite eyes
Wings	No wings	No wings	No wings
Three thoracic rings	No thoracic rings	No thoracic rings	No thoracic rings
Head, thorax, abdomen	Thorax and abdomen	Head and body	Body and tail
Legs on thorax	Thoracic legs	Legs on body	Body, tail
Horny skin	Horny skin	Horny skin	Calcareous skin
Three pairs legs	Four pairs legs	Many legs	Many legs
3 pairs mandibles	2 pairs mandibles	2-3 pairs mandibles	6-4 pairs mandibles
Breathing tube	Breathing tube	Breathing tube	Gills
Claws	Claws	No claws	No claws
No bone in tail	No bone in tail	No bone in head	Bone in tail
Lives on land	Lives on land	Lives on land	Lives mostly in water
Muscles attached to body	Ditto	Ditto	Ditto

Likeness Between.

Insects.	Spider.	Millipede.	Crab.
Body segmented	Ditto	Ditto	Ditto
Antennæ segmented	Ditto	Ditto	Ditto
Legs segmented	Ditto	Ditto	Ditto
Mouth-members	Ditto	Ditto	Ditto
Hard skin	Ditto	Ditto	Ditto
Lacks internal skeleton	Ditto	Ditto	Ditto

"United Church Schools," Class II.

G.—Mammals.

I. *Apes* (4 hands, naked face, eyes turned forward, teeth like man's).

II. *Ungulata* (hoofs, striped molars [except pig]).

(a) *ruminants* (camels, deer, horned animals).

(b) *non-ruminants*.

bA those with paired toes [pig, hippopotamus].

bB ,, ,, unpaired ,, [horses] 1 toe.

,, ,, unpaired ,, [rhinoceros, tapir] 3 toes.

,, ,, unpaired ,, [elephant] 5 toes.

III. *Insectivora* (sharp-pointed molars, snout, no wings) [hedgehog, mole, shrew-mouse].

IV. *Bars* (wings, sharp-pointed molars).

V. *Carnivora* (saw-pointed molars, tearing-teeth, a few blunt teeth) [cats, dogs, bears, martens, hyenas].

VI. *Rodents* (two chisel-shaped front teeth in both jaws) [beavers, hares, squirrels, mice, field-mice].

VII. *Whales* (fish-shaped, nostrils above the head, pectoral fins, a horizontal tail-fin, small ear-holes without lobes, smooth, naked skin) [whalebone, whale, dolphin].

VIII. *Seals* (very broad webbed feet) [common seals, sea lions, walruses].

Mammals (suckle their young, hair-clad as a rule, flat vertebræ with discs of cartilage).

"United Church Schools," Class I.

H.—What Birds Have in Common.

Wings; beak; feathers; air-sacs; one pair of legs; hollow bones; lay eggs; claws on toes; long and S-shaped necks; toothless; only one vertebra in neck; no ear-lobes; crops; hatch their eggs; scales on legs.

To Distinguish Birds from Mammals

Wings with feathers ; one pair of legs ; feather covering ; scaly legs ; hollow bones ; air-sacs ; crops ; one neck vertebra.

Division of Birds

Birds with perching feet (sparrows)	Birds without perching feet.
Birds with swimming feet (swimming birds)	Birds without swimming feet.
Birds with predaceous feet (predatory birds)	Birds without predaceous feet.
Birds with climbing feet (climbing birds)	Birds without climbing feet.
Birds with running feet (ostriches)	Birds without running feet.
Birds with wading feet (wading birds)	Birds without wading feet.
Birds with walking feet (poultry)	Birds without walking feet.

"United Church Schools," Class I.

I.—Natural History.

DIFFERENCE.

Reptiles.	*Amphibians.*
Scales.	—
—	Transformation.
Claws.	—
—	Slimy skin.
—	4 front toes, 5 hind toes,
—	breathe through the skin,
—	slimy eggs.

LIKENESS.

Cold blood, hind legs more developed than forelegs, lower eyelid movable.

"United Church Schools," Class I.

J.—Fishes.

Bone-fish.	*Cartilage-fish.*
Fins with thin skin and thick bone.	Fins with thick skin and thin horn.
Free gill-fibres.	Fixed gill-fibres.
Mouth in front.	Mouth under head.
Scales in the skin.	Teeth in the skin.
1 gill slit.	5 gill slits.
1 row of teeth in jaws.	Several rows of teeth in jaws.
—	Holes on top of head.
4 nostrils on upper side.	2 nostrils on lower side.

BONE-FISH.

Belly fins far forward.	Belly fins far behind.
Soft-finned fish : Barbot, cod, plaice, remora.	Eel, pike, sheat-fish, herring, salmon, carp.
Spiked-fin fish :	
Stickleback, perch, mackerel, frog-fish, flying fish, porcupine fish.	

"United Church Schools," Class I.

CHAPTER VII

COMBINATION OF THE METHODS

It is impossible to use the children in a school as material for a truly experimental study of methods of instruction, since it is not feasible to try each method by itself and compare the results. It cannot, therefore, be determined *with precision* what special effects each individual method produces. In most cases one can only ascertain what are the qualities in the pupil that this or that method reveals ; but from this it may not without further ado be concluded that the qualities revealed were acquired exclusively as a consequence of the method which brings them to light. Still, a certain number of results may be laid down, with a high probability of their being right ; and from these again a combination of methods can be deduced which may be regarded as the most rational possible.

That in this combination of methods extraordinary regard must be paid to the pupils' present stage of mental development will hardly be disputed. And equally it will be admitted that the pupils' interests and craving for activity should be amply met. From my experiences bearing on the results of the various methods, and from my pupils' declarations, it further appears that the pupils show a preference for just those methods which produce the best effects in relation to their mental development.

As already remarked, they take the more interest in a subject the more opportunity it gives them for real first-hand study ; and this order of preference is identical with the order of merit in which my experience has led me to place the methods. As I have pointed out, direct study, combined with drawing and painting, develops in a specially high degree the power of observation and the initiative ; it provides the pupils with a stock of true ideas about the physical, chemical, and biological facts of existence ; it accustoms them to think correctly on their own account and, with a feeling of responsibility, to prove their assertions, and to be honest and truthful. As regards the oral methods, it has been shown in how high degree the conversational method, or indeed class-hearing with questions from the pupils, surpasses the method of hearing pupils separately for the purposes of securing concentrated attention, obtaining the pupils' co-operation, stimulating their flow of ideas and their imagination, rousing their capacity for doubt, criticism, and rigorously consistent thought. Finally, it has been pointed out here and there what illusory results are obtained when lesson-learning plays a leading part.

The combination of methods which most nearly satisfies the demands of a rational education is therefore a combination of direct study with conversation, reinforced by " living pictures," text-books, and free reading, varied occasionally by discourse from the teacher, and the hearing of pupils one by one ; but in this combination special stress should be laid on direct study in the various forms which can be employed in a school.

The problem which education aims at solving is that of adapting the individual to the existing conditions of life in such wise that the individual may make the most of his life, while those who live with him and after him make

the most of his being alive and his having lived. In this definition is contained the requirements that the individual must acquire not merely the best possible adaptation to conditions as they are but also the capacity for adapting himself to changes in the conditions. This means that at every period of his life the individual must possess both adaptedness and adaptability ; and as the conditions of life are in great measure subject to change, adaptability is highly necessary.

As our own time in particular is remarkable for unceasing changes in the conditions of life, brought about by new ideas, new inventions, new political and social situations, in general by innovations in all manner of fields, and as competition within each separate community, as well as between nations or states, has the effect that the innovations are turned to account, it is pre-eminently necessary that both the individual and society as a whole should possess adaptability. One must at least be mentally flexible enough to be able to keep pace with and to appropriate the valuable novelties created by others. Indeed one should, if possible, be to the fore in some fields and enjoy advantages which others do not yet possess. But hence follows a standard of values with regard to the physical and mental qualities of the individual different from that which is and must be applied in times when novelties are rare and the pulse of life slow. In stationary civilizations, such as that of ancient Egypt, the Chinese (disregarding quite recent years), in part the Hindu, or the medieval European, the quite natural tendency of education is to impart authoritative teaching. Fixity, immutability are the distinguishing features of such societies ; the adaptation of the individual to existing conditions of life means, therefore, his being solidly standardized by the authorities, in his acquiring as much

as may be of the knowledge which society possesses and rests upon. Partly, then, because the *fixation* of the mass of things learnt takes much time, still more because it is felt, instinctively or with full consciousness, that this fixation is in conflict with the pupil's first-hand use of his senses, the latter plays an extremely slender part in the typical authoritary society ; and hence it follows again that initiative and independence of opinion are exceedingly rare. Otherwise, indeed, adaptation to existing conditions of life would not have been achieved ; for in general those members of an authoritary society who set themselves against the authorities find themselves worsted. It is only in special cases that exceptional individuals break a way through.

On the other hand, when a society is in process of brisk renovation it is less difficult for the " beginner " to choose his own path. In particular fields of neutral character, bearing but little on traditional ideas, particularly " conceptions of life," there is usually a wide opening for initiative. Indeed when it renders obvious services this quality is loudly acclaimed, e.g., the Finsen light-cure, the Röntgen rays, and so on. *It is highly probable that we are moving on to an age in which initiative, inventiveness, capacity for action, will be regarded as particularly honourable attributes, because it is instinctively felt or consciously recognized that they are valuable in the struggle for life and life's good things.*

But in the same degree as mankind, or the leading races, place a high value on innovations, so too must the valuation of man's powers be revised. Those qualities which most make for the production of what is new must be regarded as pre-eminent, and it will be the ideal of education to educate the inventor, the renewer.

Starting from this consideration, it is in the first place

the power of correct, intense, fully-conscious sense-perception that must be given a high value. The " innate experience " which the individual is conceived as inheriting from his progenitors cannot of course be in any special degree the source of innovations ; it must on the contrary bear something of an antique stamp and be approximately uniform in consecutive generations. On the other hand, the direct employment of the senses on the phenomena of existence may provide the individual with *new* experience, capable of setting in motion his initiative and his power of action. The education of the sense-organs is, therefore, of infinite importance. " Inherited experience " is hardly receptive of change, otherwise than by yielding ground to acquired experience ; it has a conservative character in contrast with the innovating tendency of the other.

It is in the child, however, that the best conditions are found for the education of the senses. What we have to do is merely this, that instead of checking the child's spontaneous activity, which largely, but by no means exclusively, consists in using its senses, *we should encourage it, and gradually teach the child to use its senses more intensely, rationally, and consciously.* The older children grow the purer becomes the activity of their senses, that is, the more it is isolated from the intermingling play of fancy, and so on. But in the younger children sensation is in so high a degree a motley product of imagination containing an admixture of realism that the result is often extremely comic.

For example, I once saw a boy of $3\frac{1}{2}$, who had received a sword as a Christmas present. He took aim with it as with a gun, and, not without wit, he called a tin plate hanging from his belt " the soldier's purse." A sailing-ship with two masts was a " steamer," and he asked

to have the masts lighted, " so that the ship can sail." But when his elder sister, who wanted to get hold of his presents, hit him with a ball and declared : " Now you are dead," he protested most vigorously against that fiction and said : " No, I am not ; because when we are dead we can't talk."

On another occasion I observed some boys of about six at play. One of them was a bull and was being led away by another who had hold of a short piece of string, fastened to the " bull's " nose with pitch, so that it looked as if he had a ring in his nose. In spite of this realism a third boy was dissatisfied with the arrangement ; for when they came close up to him he exclaimed scornfully : " Yah, they think people can stand up to a bull's horns in that fashion." I may also refer the reader to the numerous examples given in my books on child-psychology.

The examples are typical, and show how children blend observation with the products of fancy ; the educator must reckon with these facts, and while bowing to them he must get rid of that part which is objectionable when manifested in the adult. But the road to this end is not that of direct repression, as by preventing the child from giving its nature free scope, by denying it access to direct sense-perception, or by deriding its fancies. *In education stress must be laid on promoting the development of the inborn craving to use the senses ; when occasion offers one must draw attention to errors of observation and thus awaken self-criticism and the desire for thoroughness.* In this way the ideas acquired for itself by the child become gradually more and more true to reality ; and this again reacts upon imagination, in such wise that it is not checked or weakened but simply comes to be based on reality in ever-increasing degree.

Imagination is not a thing to be rooted out or held down ; on the contrary, it is to be made fruitful by a firm attachment to reality, or at least by the inclusion in it of a strong element of realism.

In accord with these theories I have always in my practice been cautious about both the form and the matter of my corrections. I never enjoin concealment on my pupils but always urge them to reveal whatever they may have on their minds. When, for example, a pupil writing about the ground-beetle, says that its two hindmost pairs of legs are attached to the abdomen, I concede to him that on a hasty view it does look like that ; I thus avoid discouraging him, but at the same time I teach him (and the others) to observe more accurately. In this way the faculty of observation is little by little trained to greater keenness in them all. Later, when the pupils have become older, I similarly take occasion to show them how errors of observation may be due to uarely psychological causes, as, for example, when two pprallel lines look as if they were inclined at an acute angle because they are cut by lines forming acute angles with them. In this way they are gradually led to practise close observation with full consciousness that in spite of all pains errors may easily creep in.

For such an education in the use of the senses, especially in the case of younger children, the material should preferably be taken from nature, more correctly from the material world. In school, therefore, the best material is provided by such subjects as slöjd, needlework, other subjects employing the hands, such as folding and cardboard work,* and by the natural sciences. If only the children are permitted to do first-hand work on the

* See Vilhelm Rasmussen : "Samfunds-Skolen," translated into Russian.

material, they exercise all their sense-organs of their own accord so far as they have opportunity. I have shown this as far as regards natural history, and in part physics, by the examples I have adduced of the pupils' tasting and smelling at plants, their feeling of animals and plants, and their extraordinary keenness in inspecting things. To these may be added their attentive listening when they are out in the open. In these domains, therefore, the teacher is not called upon to infuse into the pupil any new inclination ; his task is merely to let the pupil have free scope for inclinations already present, and gradually to transform the natural play of these into conscious, rational activity.

In the natural sciences, therefore, if only for the sake of exercising the senses, direct experience in its various forms ought to play a very dominant part relatively to the various forms of second-hand work such as reading, the lecture, and the like.

Another reason for laying the chief stress on first-hand activity is that it is the means of providing the pupil with a stock of true ideas. That to have true ideas about things is as a rule more serviceable to life than to have false ones needs no proof ; and it is equally obvious that the welfare both of the individual and of society are promoted by their possession of *a large* stock of true ideas. But it might seem to some as if the direct experience of the pupil were an inferior means compared with the imparting of knowledge by teacher or textbook when the pupil is to be provided with true ideas, especially with an ample measure of them. But on closer consideration it appears that the path of direct experience is also the one which leads the individual to *most* true ideas, *supposing it is desired that he should understand the content of his ideas, keep them reasonably*

well preserved in his memory, and have them on hand for ready use. The ordinary methods of communicating experience lead to a vast array of deplorable illusions, of which I will give a typical example. During a conversation about something or other a young man, who had recently passed a good preliminary examination with very high marks in natural history, remarked : " Aren't those things eyes that are on the ends of the cuttle-fish's arms ? " Startled at this, I asked who had been his natural history teacher, and what sort of instruction he had given. I was informed that he was a very competent teacher, " who always brought up the animals, took them out of the spirits, and showed them to us." And yet the result was not brilliant as far as concerns the cuttle-fish. Such things thus happen even when the objects of instruction have been exhibited to the pupils ; they happen much more frequently when the pupils have merely listened or learnt by heart. We think that they have acquired a large stock of true ideas because we have convinced ourselves that in the lesson-hours, perhaps also in the examination-room, they have proved their possession of true ideas. *In reality it has been more often than not merely a thin coating of varnish, soon worn off.*

The worst, however, is that the pupil becomes disaccustomed to follow his original desire for the direct employment of the senses, for independent thought, and for other modes of utilizing his perceptions, and a distaste has been aroused for reading. The consequence is that when his school life ends he is far less keen as a direct investigator than he would otherwise have been, and very likely does not read much either. But if the main stress is laid on developing the activity of the senses, the pupil will later on remain permanently a seeker of direct experience ;

possibly, too, he will have had imparted to him so strong an interest in knowledge that he will continue to read. *As an adult he will then in a very short time read and learn what children take a long time to read—without ever learning.*

In addition to these objections against stressing the acquisition of large masses of matter we have the further consideration that the quantity of knowledge possessed by the individual, important though it may be, *is yet of far less value than his power of continually acquiring new knowledge and turning it to account.* Many who possess a large stock of knowledge arrive nowhere, and many who originally were ignorant acquit themselves with credit. The first in point of fact are unable to add to their knowledge and in particular do not understand how to use it ; with the others the case is reversed. *But here it is not merely inborn capabilities that count ; education, too, plays a large part, for, as I have shown, direct experience releases the pupils' initiative and power of action.* It may indeed be doubted whether it is the practice of investigation that *produces* the initiative and the action. The case rather is that initiative and activity are original, deep-seated attributes of the child's being, which direct experience merely brings to light. But for the main question the point is of no importance. It is a fact that initiative wakes and becomes manifest when the pupil garners experience at first hand, while it is the rather repressed when he has experience imparted to him. If one has told a pupil, even if one has shown him, that a magnet can attract a needle in air, it is not likely that he will think of trying whether it will also act in water. But such an experiment may well occur to a boy when he has himself tested the attraction in air.

But just as initiative and activity thrive when the main

method is that of direct experience, so also will is provided with the best conditions for growth. Properly speaking, it is irrational to say that activity receives free scope and *also* will ; for the child's immense craving for action is itself a manifestation of will. But educators have set their hearts on another form of " will." They want the child set to a task with a " shall " behind it ; and if it then works at full power they are simple enough to think that it " wills." In reality it is the teacher, the school, or some other authority that " wills," the children " shall." Wholly to avoid tasks which are imposed on the children, and which teach them among other things that one must at times do work not dictated by one's own inclinations, is indeed hardly possible. *But if we think that in such tasks there lies the best possible education of the child's volition, we are guilty of a gross error. In all the situations of life the most valuable work is that which is prompted by inner, personal motives, either the purely involuntary impulse to activity or the conscious pursuit of a goal, or the two together. What a person only does because he is set to do it, forced to do it, carries him nowhere. School, therefore, is training the pupil in the worst form of will, in sham will, when it forces on him activity which does not spring from, or at least concord with, the impulses of his nature.*

But, granting that the adult must perform a great mass of work imposed on him by duty or necessity, need this fact be stressed to the point of making it a reason for tormenting children ? Surely not. Indeed, for the very reason that the adult cannot escape a certain amount of forced work *we should do what we can to spare children from it. Give the children, in the fullest extent possible, facilities for unfolding their nature and working in accord with their own inner promptings : they will not only*

achieve much more than they would otherwise—they will at the same time develop so strong a leaning towards the spontaneous type of volition that as adults they will provide themselves with leisure-tasks if their necessary labour does not arouse their interest. And there can be little doubt that for every man it is of the highest value to have private interests to cultivate, especially for those whose daily round inspires tedium. The main reason, however, for educating children's wills by giving them the opportunity of doing work in which they can become engrossed is this, that *only that work in the performance of which one forgets oneself, does not notice time, does not think of anything else, is the one truly ideal form of existence. To pass from activity to activity carried on in this manner is to live a full and complete life, so far as work is concerned.* To accustom children so to live is therefore to adapt them to the highest form of work. To educate more and more individuals in a society, all of them if possible, into this type of worker *is to create a workers' civilization of the highest rank.*

That this goal cannot be attained is no proof that it is wrong to strive after it. If we believe that the imposed will is a good education in volition, we shall trouble ourselves little about the child's interestedness ; but if we take it as essential that the child should of its own motion immerse itself in its task, value it for its own sake, we shall endeavour to provide the child, in the highest measure possible, with work that directly appeals to it and which at the same time is serviceable to it in the later stages of life. *As leading principle we must therefore maintain the postulate that the child ought to be deeply interested, that it should be induced to work by its own craving for activity. Due regard, therefore, to a really good education of the will is another reason why direct*

study should rank far above the communication of second-hand knowledge.

I have here taken " will " in a wide sense, embracing all forms of motive for action. But also the higher form of will, in which there is present a conscious choice of end and means, perhaps too of speed, receives a good education when the direct investigation of nature is employed. Conscious will, in fact, depends largely on clearness of ideas, the necessary condition for the determination of the right end, the right means, the right speed ; but, as we have seen, clearness of ideas is powerfully promoted both by the clear content of the natural sciences themselves and by the pupil's continual effort to appropriate that content in such a way that it may become entirely clear to *him*. It is particularly this last point that is of importance ; *for the habit of forming clear ideas respecting the phenomena of nature tends to spread, and manifests itself in the formation of ideas about other matters as well.*

But even admitting that the growth of the child's will and his accumulation of truthful experience are best served by placing direct study well to the forefront, many will perhaps think that with this procedure the *emotional life* is left fallow. It is especially from the followers of Grundtvig that this objection is frequently heard, but it is urged by others as well. *The point at issue is, however, not the question of some emotion or none ; the dispute is one about valuable, less valuable, or wholly undesirable emotions.* Listlessness, boredom, disgust are just as truly emotions as lively interest, enthusiasm, or the silent but deep joy felt during work which wholly engrosses, a joy of which the worker does not become conscious till he has finished his work and looks back on it. It is, therefore, a misunderstanding to suppose that direct study is not an education for the emotional side of child-

nature, for the child's capacity to put feeling into its experience, and thereby again to stimulate its will. While those waves of feeling which enter children's minds when the teacher causes *his own* waves of feeling to pass over into them are artificial and often unreal, the feelings bred of independent work are honest and genuine, determined by each child's peculiar attributes and the character of each situation. In this field as in that of will the motives that come from within are the most valuable.

For the education of feeling, therefore, the preponderance of direct experience is again the right principle. Of course indeed the emotional side of a child cannot be developed fully and wholly on the exclusive basis of direct nature-study ; nor is there anyone who asserts this. *But the natural sciences make their best contribution to the emotional development of children when these are placed in direct, unmediated contact with the phenomena of nature.*

CHAPTER VIII

THE RELATIVE VALUE OF THE SUBJECT-MATTER PROVIDED BY THE NATURAL SCIENCES

If on the grounds here put forward principal stress be laid on the pupils' direct experience, a number of important consequences follow with reference to the subject-matter on which the pupils are set to work in the different natural sciences. But before entering into this more fully I will first draw attention to two principles, recognized in theory but very often denied in practice, which bear on the treatment of a subject. I am thinking of the maxims which bid us *proceed from the nearer to the more remote and from the simple to the complex.*

The first of these principles does not turn on one starting from what is nearer *in the physical sense* and going on to what is *physically* remote; *the distance which we are called on to measure and to regard is the psychological distance.* It is what the child feels mentally nearest that is to come before what it feels as far removed from itself; *no other standard is here applicable than the one which the child itself supplies by its spontaneous manifestations of interest.* The consequence, more often than not, will be that the physically nearest turns out to be also the psychologically nearest; but this must not deceive us into thinking that the case is always so. As far as girls are concerned, dolls and all their purtenances will be very much

nearer than most of the other objects in the home, though these, physically regarded, are quite as near to them. For most children at a somewhat more advanced age the stars will be nearer than the stones in the field; in any case they question their parents about the stars long before they begin to show any interest in the qualities of stones.

Of course it must also be taken into consideration that the physically near is often so well observed by children that they themselves feel their own observations exhaustive and therefore seek no further information. But as a rule their interest will betray itself either by questions or by their occupying themselves with the phenomena of their own accord; and it is the phenomena so indicated which at every stage are to be regarded as "the nearest." The simple fact that they best reveal the interests of children is among the reasons why direct experience and conversation are entitled to precedence over all other methods.

The second of the fundamental principles just mentioned is in like case with the first. It is very true that we ought to proceed "from the simple to the complex"; but this, be it noted, is on the understanding *that it is the child's attitude to the phenomena that decides the matter.* For a child a "puffer" is something quite simple; for the adult it is very highly complex. But in education it is the child's view that must be taken as fundamental. If it were the adult's, the insoluble question would at once arise: *which adult's view is to provide a basis?* The layman sees among the details which together make a train but a few out of the multitude which a physicist sees. But even the latter is in a worse position for analysis than the specialist in train-building. The difficulty is not overcome by suggesting that the adult, the educator, may tell the child those details which it can understand, which it must understand if it is to under-

stand the whole. In this case we are back at the child again, and if he wishes to make sure of its understanding the teacher must build on its expressed opinions and its spontaneous manifestations of interest. But why this circuit? *Why not let the child itself decide at the outset how far the phenomenon is a detail or an assemblage of details?*

From the teaching of physics the steam-engine may be taken as a further illustration of my position. In accordance with the ordinary interpretation of the maxim: "Proceed from the simple to the complex," the teacher as a rule gives a preliminary course on the properties of steam, which does not rouse the involuntary interest of the children. *Instead of this he ought to begin by letting them see a steam-engine at work; this will interest them fully.* So I have made it. They then ask questions about one or more details; or the teacher, without too obviously contradicting the children's impression of simplicity, may himself put a few questions. The pupils will thus, quite naturally and with fully sustained interest, go on to investigate those details which must be understood if they are to understand the steam-engine. *By being too analytic at the outset the teacher not only prevents the "elements" from being assimilated, but at the same time causes the combination of them to lose its alluring and interest-arousing quality.*

But if we are to take the right method of passing from the near to the remote and from the simple to the complex, and if we are to lay the main stress on the pupil's direct experience, we shall be driven to radical changes as regards the subject-matter which the pupil is set to work on in the different natural sciences.

The least change is required in physics and chemistry, so far as laboratory instruction is given. But even

supposing these subjects acquired by means of the pupil's laboratory experiments, supplemented by occasional experiments which the teacher performs with the pupils' help, it is not to be supposed that all is well. It is essential, for example, that the apparatus employed in the discovery of physical laws, or in the carrying out of other work, should be made *as simple as possible*. By preference, *the pupils should be able to make the necessary apparatus for themselves*. The impossibility of this principle being carried out in its entirety is no reason against its being followed as far as it can be. If the apparatus has been made very simple and if the pupils have found out for themselves the most elementary physical and chemical laws, we may without scruple allow them to leave school even if a mass of involved physical and chemical facts are quite unknown to them. What they have not learnt in the right manner they know, as a rule, only in appearance. Fortunately laboratory-work, and partly too physics-slöjd, is quite general in the higher schools, and as we may hope will soon make its appearance in the elementary schools as well.

In the case of natural history the demand for the precedence of direct experience entails considerable changes as regards the subject-matter that children are set to work on, particularly in botany and zoology, but partly also in human anatomy and physiology.

In the case of botany the great types of plant-community, the forest, the heath, the moor, the field, come into the foreground (the one or the other according to the nature of the locality), together with their seasonal attributes (winter garb, etc.), while division by species is left in the background without being quite ignored. In the next place satisfaction must be given to the pupil's æsthetic needs and his interest in the manifestations of

life. The child who busies himself with plants partly has æsthetic motives for so doing and partly is striving to satisfy the vital needs of the plant, naturally without being aware that the plant is a living thing. It is thus the plant's manifestations of life that most strongly engage children's interest, and hence they pass on to an interest in the individual types' peculiar conditions of life, their structure and their vital reactions. But systematic botany has no interest for children, and so again those properties of plants which are mainly noted for the sake of their value in relation to the system do not immediately rouse interest. I refer to detailed accounts of the " structure " of flowers, e.g., number of stamens and the like. If, on the other hand, it is obvious that this or that peculiarity in a flower has biological significance, e.g., for pollination, it at once becomes interesting. The movement away from the system, which in part has already triumphed, should therefore be followed up by a movement away from details of merely systematic interest to details of biological significance, both in plant-communities and in the species and genera that are made the object of closer investigation. A small dose of system, presented in the broadest outline, is something which the pupil can easily cope with ; detailed systematic is of no earthly use. That it is profitable to have a little practice in finding similarities and in arranging mutually concordant forms in higher units is another matter ; this ought not to be developed into a fully comprehensive family-systematism.

With zoology the case is somewhat different from what it is with botany, because, in our fauna at any rate, there are no great forms of community corresponding to those found in plant-life. The few community-forming animals that we have are not well suited for study by

children. Therefore in zoology it must be the individual which is presented as an object of study, serving as type sometimes of a species (sparrow), sometimes of a genus (frog), of a family, and so on. But if the leading part is to be played by direct experience, whether in the open or in the form of observations carried out in the school (or at home), zoology must be linked with botany in such a manner as to bring out clearly the interrelations of the organisms ; and, more especially at the beginning, those animals must be preferentially studied which the pupil can see alive (in aquaria, terraria and cages). In addition there must be a pruning-down of the quantity of material in order that time may be gained for investigation.

Contact with botany may be established by grouping the animals, at any rate when the subject-matter is first gone through, in accordance with their habitat, e.g., fresh-water fish, forest animals, sea animals, and so on.* The fact that particular animal-forms cannot without some difficulty be worked into such a scheme is of no practical importance. As an example I will merely mention the parasites, as tape-worms, trichinæ, and the like ; they may either be taken in conjunction with cognate, non-parasitic forms, as is now usually done, or they may be brought together in a general treatment of parasitic life in the animal kingdom, e.g., in connection with hygiene.

In order to give the pupils facilities for studying living animals to the greatest extent possible it will be necessary to depart from the ordinary practice of beginning with man's nearest relations, the mammals, and ending with the least developed types. The mammals are in the main not very accessible for study, partly because we have so few types living lives of liberty, partly because of their

* See F. Junge : " Der Dorfteich als Lebensgemeinschaft."

habits. Conversely, there are among the lower animal types a large number which can be observed alive, partly in the open and partly in the schoolroom. In school I have had the following: moor-snail, planorbis, fresh-water mussel, bean-mussel, horse-leech, medical leech (bought), crab, fresh-water woodlouse, water-flea and other crustaceans, larvæ and nymphs of the dragon-fly, water-bug, water-beetles and their larvæ, water-devil, caddice-fly larvæ, gnat larvæ, water-spider, water-mite, bastard carp, tench, bleak (goldfish), perch, pike, eel, stickleback, salamanders and their young, frogs and toads in their different stages of development, and mud-tortoise (bought). Among forest animals the pupils have on their excursions caught: lizard, slow-worm, vineyard-snail, garden-snail, wood-snail, and other animals, which have been kept in a simple terrarium, a large, deep glass case with a moist moss bottom. A considerable number of types have been seen by the children out in the open; and they have interestedly studied, drawn, and written essays about the types contained in the school's natural history collection. When each pupil has just a few animals, as I have already said, he can take them all in; and it then appears that the principle of starting from the nearest and most closely related, correctly understood, is thus complied with. The fact that the object of study is alive, as in the case of the animals in an aquarium, or that, at any rate, the pupil has seen it alive, as in the case of butterflies, ground-beetles, etc., causes him to feel it as nearer and more related to him than a monkey or some other mammal which he cannot observe alive. I am not referring here to the very first instruction in natural history; this must begin with the animals in and around man's dwellings, dogs, cats, and so on.

In his interesting works on the observation of nature,

particularly the phenomena of animal life, Magister Asger Ditlevsen appears to me to have in some degree failed to perceive that both in practice and in theory I have laid more stress on the direct study of biology than he says when writing of my books and my method. I may refer not only to the preface, which has not been altered since the first edition, but also to such essays as that on "The Class Aquarium" and to other quotations from pupils' essays. But I willingly admit that I have never gone so far as Magister Ditlevsen. I approve his aims; but if all his promises are to be fulfilled either many more hours must be given to the observation of nature, "natural history," or else Ditlevsen is unreflectingly counting his numerous woodland excursions as part of the school's obligatory instruction. But that is not permissible. The excursions must in any case be voluntary for the pupils, but neither is it possible to impose them on the teachers as a duty. Four excursions in the year, say from 10 to 4, makes 24 or at least 20 hours of open-air instruction additional to the school-hours; and this is no inconsiderable addition, as there are hardly more than 80 school-hours allowed to the subject.

If biological facts are to be observed there must be a really intimate knowledge of the structure of animals; otherwise one gets no further than bird-notes and peculiarities of flight. I do not care, therefore, to go so far as Magister Ditlevsen, but of course the maximum possible of biology is excellent. With this reserve, that biological knowledge is not to be fed by spoonfuls in the form of a "Danish Reader" on the life-conditions of animals; for that is an indirect way of saying to the children: "Here you can read about the shrew-mouse, so you need not trouble to observe it."

Nor can we build on the pupils themselves making

observations on their free days, for the one cannot observe for the other. Each separate pupil will possibly make for the open and see something, but what is seen is quite an individual matter and depends, e.g., on such circumstances as whether the buzzard is kind enough to perch on a gatepost while the boy is in Klampenborg Park. Granted that an eminent biological observer like Magister Ditlevsen can find much to observe, he must on his side not forget that we others have also been in " the wood " and know how much an affair of chance it is what material is offered us by nature for the observation of animal life.

In speaking of the material as needing to be pruned I am not thinking particularly of the text-books. Their importance is subordinate, if the chief stress is laid on direct experience ; and there is no harm in their retaining their present compass practically unchanged, and in their naming the old established types. But the teacher must allow the pupils to pass over now this type and now that, or content himself with a very cursory demonstration of a particular animal and a short mention of it, while the pupils, in compensation for learning but little about some animals, have studied others so much the better. This will not bring about diminished knowledge of our fauna ; for the more interest-rousing method imparts a desire to know animal forms, while the old-fashioned methods, in spite of most praiseworthy efforts to give the pupils comprehensive knowledge, led, as a rule, to the result that nature-knowledge became a matter of indifference to them. Out of school, out of mind !

As regards hygiene it must be remembered that it occupies a special position as being so distinctly a " utility-subject." The pupil is set to learn the structure of his body and its vital activities in order that he may

understand the conditions for bodily, and therewith mental, health, strength and beauty. But as it is quite possible to know what is the right way of ordering one's life without acting in accordance with one's knowledge, it is one of the tasks of hygienic instruction to make the right conduct of life so interesting a subject that the pupils receive a strong impulsion towards rational living. This interest is best imparted when the instruction is based on experience which the pupils are in a position to check, or even to garner directly. *Therefore in the teaching of hygiene once more the endeavour to promote the pupil's direct experience must be as vigorous as possible ; and it must be the subject that sets the impassable limits for such direct experience.* On a first consideration one might perhaps think that there is practically no possibility of the pupils experiencing for themselves anything relating to the structure and vital functions of man. But that is a mistake. It is only that we are not accustomed to let the pupils observe themselves. As a rule, therefore, things go as they went on one occasion when I was acting as censor at an examination of a class of girls from fourteen to fifteen. One of the older girls was asked by the teacher to state the number of joints in the human fingers ; and as she did not know the answer she stood dumb and inert instead of looking at one of her own hands. This case is typical of a great deal of instruction in hygiene. The children learn a mass of facts about man, *but they never realize that it is about their own body that they are learning, and that they can observe quite a large amount.* In order to give my pupils really direct experience of man I have employed several methods of procedure. I have set them to observe each other, two by two, to the extent permitted by their clothing. I have set each pupil to write about himself ; and as clothing here need not be

taken into account, the description may be more comprehensive. During lesson-hours I have in the course of conversations made them all observe their skin and other external organs, such as hair ; in speaking of the skeleton I have got them to feel all the bones that can be felt, I have got them to indicate and trace the outlines of their hearts, stomachs, lungs, and other organs, naturally using at the same time anatomical charts as material for observation. While the broad lines of anatomy have thus been made an object for direct experience, the same has been done for particular physiological processes. As examples, I will merely mention that the pupils have studied for themselves how speech-sounds are produced, that they have seen the importance of mastication demonstrated by being shown how the area of solid matter affects solution, that they have seen the transformation of starch effected by saliva, and the evidence of carbonic acid in expired air supplied by its effect on lime-water, and so on. It is possible to conduct quite a considerable series of experiments in verification of the statements on normal and abnormal physiology which are included in hygienic teaching. Demonstrated and apprehended through the senses in this way, the knowledge of the conditions for a healthy mode of life and of the dangers of unwholesome habits will produce a much greater effect than if it had been merely imparted authoritatively or read in a book. On the other hand, time may be saved by passing over useless details such as the number of the different types of vertebræ. It is quite indifferent for the individual's personal hygiene whether he knows that he has five pelvic vertebræ or four rudimentary caudal vertebræ. To facilitate the knowledge of man's internal organs the teacher may dissect a mammal, e.g., a rat or a cat. It has always interested my

pupils to be present at such an anatomy lesson, and they have learnt to understand much that was obscure, e.g., what muscles, nerves, etc., really are.

The chief changes desirable in hygienic instruction are therefore, as far as concerns subject-matter, *omission of useless details and a more copious treatment of physiological facts, illustrated by experiments and a little mammalian anatomy*.

The natural science which needs most change in respect of the subject-matter treated in school is geography.

Geography is one of the most difficult school subjects, partly because of its own nature, partly because of the advances made in recent years by the methods of instruction in other subjects, particularly the natural sciences.

Geography is a blend of mental science and natural science. It ranges from architecture, sculpture, and painting, to soil, the history of the earth's strata, and astronomy. There is, therefore, a great danger of the pupil acquiring a smattering of many different sciences without grasping those causal relations which can be pointed out in certain fields and which lie within a child's power of comprehension. Even for adults it is a heavy task to acquire the comprehensive knowledge of a number of subjects which is necessary to prevent the details of geographical descriptions from becoming a mere accumulation of disconnected phenomena ; and children, of course, except in the most favourable cases, possess but the slightest preliminary qualifications. During geographical instruction they need, as a rule, to be introduced to even the elementary ideas of the subject. They are ignorant of architectural styles, have no idea of picture and sculpture galleries, have no sense for or understanding of art and literature, barely of science ; and yet we teach them about the highest manifestations of

man's creative faculties. If the teacher, or possibly the book, gives a satisfactory explanation of the relevant concepts it is all to the good that the teaching should contain a fair measure of the history of civilization ; but if the ideas are not explained the pupil gains nothing but a collection of empty words.

The situation is certainly better as regards the natural science side of the subject ; but the pupils are in reality far from possessing the qualifications necessary for understanding the ideas they make free with. Even for pupils of the " real " classes the Amorican and Caledonian mountain-systems are something of a mystery, however glibly they may be able to parrot the words of the book. Even notions like mountain, highland, mountain-chain, plain, or steppe are not properly known by children though they may know their geography by heart.

So comprehensive are both the mental science and the natural science elements in geography that from this cause alone the subject is extraordinarily difficult, as long as one does not limit oneself to treating the pupil as a kind of phonographic cylinder from which one is content to hear what a phonograph can do equally well.

To the difficulties, arising out of the fact that geography theoretically embraces nearly all the other sciences, must be added those due to the advances in method which have been made during recent decades, especially in the natural sciences. The more the pupils come to work as first-hand observers in natural history, physics, and chemistry, the more unfortunate it becomes that neither the natural science nor the mental science elements in geography can be assimilated by independent investigation, except as far as relates to the home district. No child, except the quite few who go abroad, can make direct observations outside our own country ; and it is

hardly the usual practice to carry on geographical observations in the neighbourhood of the school, either during the first fundamental instruction or in the later stages. But when the pupils have abundant opportunity for independent investigation in the natural sciences, it has a depressing and interest-quenching effect if in the geography hours they merely receive second-hand statements regarding natural and other facts which *could* be made objects of their direct observation.

Then, besides the difficulties here indicated, we have the extraordinarily large number of names of mountains, rivers, towns, and so on. The acquisition of all this information gives the pupils so much trouble that it often stifles interest, and in any case hinders the formation of any clear mental picture of the realities. A pupil-teacher at a seminary school was not entirely without justification when she began her lesson one day with the question : " Who knows some of the lovely names we have for to-day ? " The mass of " names " in every lesson is so great that the realities named by them are apt to be obscured. Once when acting as inspector I heard a teacher ask her pupils for the names of the railway stations from Frederikshald to Christiania, and they knew them ; but they had not the ghost of an idea about the land-configuration or the vegetation of Norway.

If the teaching of geography is to be modified in the right direction one condition for this is the scrapping of a considerable quantity of material, especially in the topographical section. Of course geography-teaching has, among other tasks, that of imparting to the pupils a certain stock of positive information ; but there is a great deal of exaggeration on this point. Given the utmost devotion to topography, it is quite impossible to provide the pupils with topographical knowledge of such

comprehensiveness that, later in life, they can be content with the information stored in their memories whenever anything of general interest happens anywhere in the world. The Great War might have taught us that. Was it not for most people something of a poser merely to grasp, from memory only, the relative situations of Montenegro, Serbia, Bulgaria and Turkey? But they were in really bad case when the papers contained news from Cettinje and Sophia—actual capitals of States. No one, except a specialist in the geography of the Balkans, knows from memory the situation of Podgoritza, Berane, and other places to which the war lent topical interest. We have to recognize, therefore, that even the best-informed person has a very small stock of ready-to-hand knowledge when he has serious occasion to *use* his knowledge, and that for daily use we all of us manage to get along with an extraordinarily small fund of geographical information. On the other hand, it is important that when events arise such as the Balkan crisis, the Morocco conflict, the World War, everyone should be in a position to provide himself with the knowledge required for an understanding of the events, at any rate in their broad outline. To some extent the daily press now aids its readers by publishing maps. These are, however, somewhat defective, as they give only frontiers and river-courses, but omit contours and other important information. Those, therefore, who wish to be abreast with their times in point of historical geography must at least have recourse to good maps (which they must be able to read) and to books if they desire more ample knowledge; and in our days every great event has world-wide significance by reason of the intercourse and co-operation which binds all lands together.

Since then, in spite of all possible pains, children

cannot be supplied with topographical knowledge which will suffice when occasion arises for its use, geographical text-books ought to be subjected to serious review with respect to their topographical content; for only the fewest teachers dare contradict a book, and this may sometimes be dangerous. Once at an examination in natural history I had an inspector who asked explicitly how many cotyledons the pilewort has; it was down in the book; and after a pupil had shown that he was unacquainted with brain, spinal cord and nerves, the inspector asked him if he did not then know the sympathetic nervous system, and was certainly somewhat offended when I remarked that the point could hardly have much interest seeing that the pupil was ignorant of brain, spinal cord and nerves. This shows how inspectors can fasten on the minor matters they find in the books without having any sense of what is important for education.

In the case of geography this deficiency of educational sense reveals itself in the vast array of names which, merely as a matter of established usage, are enumerated in the text-books, even the best of them. In a school-book which came out in the 'nineties there was set down so large a number of bathing resorts, six for France alone, that one might be inclined to believe that the author was a specialist in this department of knowledge. But even if the text-books now in use are free from this arbitrary lumber, they are heavily overloaded with useless name-material. In dealing with Further India, for example, the three longest rivers are named, while the name of the Siamese river, the most important for us Danes, is never mentioned. When the German coasts are described, not only are the Kurisches Haff and the Frisches Haff named but also the Dollart and

Jade bays, though it would really have been quite sufficient to point out that there are bays of different character. Of course, a large stock of knowledge is a good thing if one can hold it, and *if its acquisition has not been at the expense of far more important work.*

These two examples will illustrate the general tendency of my views on the pruning required in the matter of names. If it were thoroughly carried out for the whole of geography, time and strength would be left for much more valuable exercises than the mere training of the memory.

If one has the opportunity of hearing, as inspector, how children have been taught, one soon notices that as a rule they have worked very conscientiously at the memorizing of their lessons, less so at the acquisition of a solid knowledge of the map, and very little so far as concerns understanding a map and making observations for themselves. At the "real" examination in one school the pupils literally knew their text-book by heart; the teacher said hardly a word at the examination. Their comprehension, however, was at times very defective. For example, one of them asserted that the difference in level between Lake Erie and Lake Ontario was 10 metres, and was greatly astonished when I asked how, then, Niagara could be 50 metres high. But the ability to understand a map is particularly slender. The direction from left to right is conceived as west to east, irrespectively of how the parallels run; in the same way the up and down of the map are taken as synonymous with north and south. Even the teachers speak of the Rhine running *up* to Holland or mention travelling *down* to Switzerland. These points may, perhaps, strike most people as trifles; *but just these little things show that the reality has not been presented, in concrete*

form, to the mind. The symbol, the map, itself not properly understood, has taken the place of the reality.

Just as the pupils have no certain understanding of the lines of latitude and longitude, so they are at sea with the colours by which heights are conventionally indicated. For example, they call green areas steppes instead of lowlands, and areas of uniform dark-brown mountain land instead of plateaux.

To these defects may be added that gross errors are committed in respect of the phenomena of general geography. One may hear even teachers affirming that *the air* falls down as rain through rising, or that rain comes when the air *strikes against* the high mountains, or that lakes are salt because they are the remains of primeval seas. Far more frequent, of course, are similar errors on the pupils' side. We have filled their memory with fragments but omitted to cultivate their powers of observation and reflection.

If we desire to escape from faulty methods of instruction by the use of rational means rather than by trying haphazard experiments, we must get our minds clear on the special task of geography in education.

Though all subjects have, in the long run, the same final purpose, each yet has its own special office to fulfil. We cannot teach Roman culture by gymnastics. So also geography has a mission of its own. But it does not follow that this subject should entirely omit making its contribution to the solution of the most essential tasks of education: the rousing of the pupil's interest, exercise of the faculty of observation, of independent thought, initiative, imagination, feeling and will; even if in these respects geography falls behind the natural sciences, slöjd, and other subjects, it yet offers possibilities of attaining far better results than are now attained.

BIBLIOTECA

First and foremost it is essential that the geographical subjects treated should correspond to the pupils' stage of development at the moment, in order to be capable of rousing their interest ; but to this consideration no noticeable regard is paid either in the text-books or in the syllabuses. In the Intermediate School, for example, teaching *begins* with the European civilized communities, the geography of which the children in the youngest classes have difficulty in understanding ; and it is not till the third or fourth class that those foreign parts are reached whose *primitive* inhabitants the older children are becoming too old to be interested in, while the younger children would hear of them with the greatest interest. Of course, it may be objected that there are also civilized communities in these foreign parts ; but these communities are quite properly dealt with somewhat superficially, and practically with an exclusive regard to their industries, which children can understand.

Next, after rearranging the material in accordance with the pupils' interest, *it is important to make it accessible to observation, reflection, and imaginative treatment to the utmost extent possible.* Direct observation can, of course, be set on foot only in the neighbourhood of the school, but pictures and maps may be had anywhere.

With regard to the arrangement of the subject-matter, these principles require that the very first instruction in geography should, as hitherto, be concerned with the home district, but that it should be given, in the highest degree possible, in the form of *direct* investigation of that district's nature, sky, sea, or fresh water, configuration, etc. The notions acquired in this study of the home district are the foundation for the understanding of other parts of Denmark and of corresponding features in foreign

countries. One of the chief reasons why children fail to understand geographical facts is that they have never properly observed their own district. There they should make themselves acquainted with climate, the mean temperature of the coldest and warmest months, wind directions, the phenomena of precipitation, and so on. Apart from mountains, which are lacking in our country, their home study will supply a good foundation for the understanding of most of the ideas which present themselves in the natural history department of geography. The study of the home district has, at the same time, the advantage of satisfying the main requirement of good pedagogy : it rouses the lively interest of children and stimulates them to vigorous independent activity. Of course, this home study should not cease in the older classes, but should be occasionally carried further, e.g., during excursions, when opportunity serves for these.

From the study of the home district there radiate two natural extensions, one to the history of civilization in our own country, one to the primitive peoples in foreign parts of the world. It is *primitive* man that children specially understand and are interested in. It is, therefore, well in accord with the course of their development that tumuli and the like should lead on to our own prehistoric times and that these again should lead on to the primitive races. But this involves an entirely new arrangement of the subject-matter. The different parts of the world will be treated in the following order : Australia, America, Africa from south to north, Asia, Europe, and finally Denmark, when the pupils have become qualified to understand the higher manifestations of civilization.

In order to make the observations of foreign lands possible to the pupils the utmost possible use must

be made of pictures in all forms, particularly the cinematograph.

As a defence against the vulgarizing of the cinematograph a censorship has been introduced. It would be more effective to use the cinema regularly as part of the means of education. It would be an appetizer of the highest value. Naturally, it can only be isolated phenomena that are thus presented; but in their collective effect they would give the pupils a much better idea of foreign lands and peoples than they can obtain otherwise. Suppose, for example, that pictures are shown of Chinamen planting rice, of Vesuvius in eruption, of North Sea fishing. The pupils not only have their interest roused to boiling-point, but they also receive a whole series of indelible impressions and experiences. According to my observations there is no form of picture that creates so lasting an impression as the cinematograph picture; and a nearer approach to reality cannot be made by any other substitute. When once in a blue moon my pupils see geographical cinema pictures they can, as a rule, tell much more about a region and its inhabitants than it would be possible for them to learn in many hours of school teaching; and they retail their knowledge with a curious fanatical eagerness, carried away by their appreciation of the fact that reality can be seen so vividly on a sheet of canvas.

If Greater Copenhagen took the lead and procured a few series, or hired existing geographical series, or made an arrangement with cinemas, we could have an educational instrument of miraculous efficiency; the films could circulate from town to town so as to benefit the schools of the whole country, at any rate in the market towns and some of the villages.

Next, after the cinema, common lantern pictures are

the best means of appealing to the senses. Like cinema pictures, they have the advantage that they can be made large enough to be seen by all the children at once; and in a manner they supplement the cinema. The latter illustrates a single action passing through many stages, lantern pictures present a series of views of many phenomena. A well-chosen series of lantern pictures can thus give an excellent idea of the concrete features of a region. Children understand this well. One day when I had shown some pictures of Norway, a boy exclaimed: "It was a good thing we saw the pictures, Mr. Rasmussen, for I never understood before what a mountain is."

Lastly there are, of course, ordinary pictures in books, wall-pictures, and postcards; they all, however, are more or less under the disadvantage that they cannot be seen by all the children at once, so that it takes time to exhibit them.

When the picture fails us, and it does not carry us very far, we must rely principally on the use of the symbol in place of the reality, i.e., the globe and the map. But to make their use really profitable the pupils must be accustomed not merely to "find" the places; they must learn to read a map, and that can be done to advantage only by drawing. But to make map-drawing really fruitful it must not be bare copying. There are to be bought sheets with ready-made lines of latitude and longitude on which the pupils can draw coast-lines, etc., with great ease; but these are to be avoided. It is particularly the work of *understanding* and *drawing* the meridians and parallels that yields profit. If a class is going to draw a map, say of Africa, one should first get them to look at a globe and make sure that they are familiar with the lines on it. After that they should

carefully observe the wall-map and the map of Africa in their atlas and compare the parallels and meridians in them with those of the globe ; they will learn, among other things, that the Africa of the map cannot be completely accurate. They then draw their parallels and meridians ; and to make this task as simple as possible, and at the same time a piece of independent work, both sets of lines may be drawn straight, either both the same distance apart or with the distances found in the middle of the map. After these lines are drawn and the number of degrees added, the deviations from the atlas may be examined, and the pupils will learn what errors are thus introduced, understanding at the same time that all points may be given their true latitude and longitude relatively to the distorted system of guiding-lines. The coast-line may now be drawn. After the necessary number of points have been marked at the proper longitude and latitude (see Fig. 18), then the most important rivers and lakes may be drawn in like manner. Then comes the turn of the mountainous regions, and there is an opportunity to teach the pupils the meaning of the small lines by which the slope of a country is indicated and the manner in which the lie of the mountains is shown. The map is painted with water-colours, in such a way that here again the conventional significance of the colours is learnt by practical work ; and finally the towns, etc., are inserted. When the map is finished, the pupils have learnt or revised the meaning of all the symbols employed in maps, they have very carefully observed the region they have drawn, and lastly they have familiarized themselves with the principle that one should make industrious use of the map in reading geography. It is, therefore, very rare that my pupils cannot walk right up to the wall map and point out an

assigned place, and in the older classes they are tolerably well able to study a map for themselves. They can find mountain-regions, rivers, etc., which are not mentioned in the book ; up to a certain point they can also understand ruling causal factors.

Examples of finished maps may be seen in the coloured

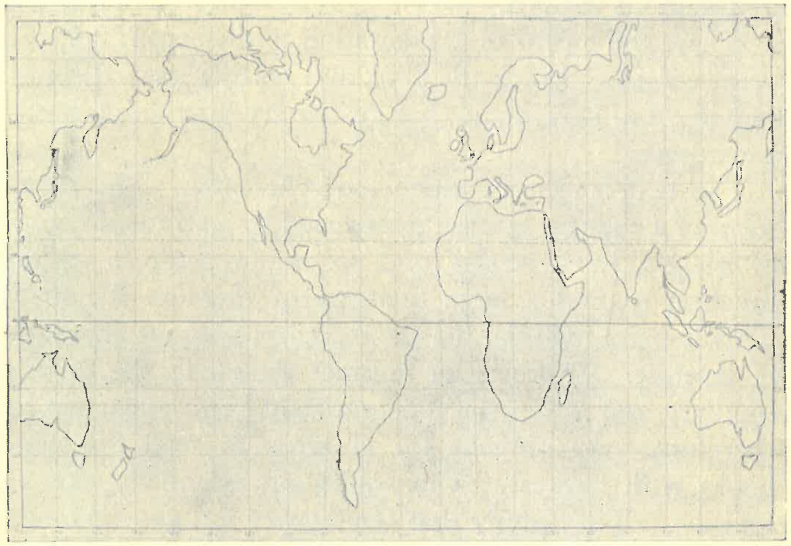

Fig. 18. Map of the world.

Incomplete map of the world. Lines of latitude and longitude arbitrarily altered from Mercator, with equal distances between the parallels, except 60-70° N. L.

reproductions. Australia is the first to be drawn, in Class I Intermediate ; then comes America. In Class II Africa and Asia are drawn, in Class III Europe, and in Class IV Denmark.

As aids to their work the pupils use only pencil, ruler, and waste paper for measuring with. Water-colours are provided by the teacher in small bottles, so that the pupil merely pours the required portion into a colour saucer. Of course, the colours must be very thin ;

otherwise stains would arise in the painting. As a rule the following colours are used: Prussian blue for sea and lakes, Hooker's green for lowland plains, the colour of the paper for the least elevated uplands, burnt sienna for somewhat higher lying plains, and a darker brown such as sepia for the most elevated plateaux and the mountainous regions.

Where the means of presentation to the senses fail, the point comes at which the book and teacher's words must step in; but here, again, our customary instruction needs amendment.

The text-books are much too schematic. The treatment of a country is often introduced by a string of names of islands, bays, straits, and so on, or there is an injunction to find a large quantity of them in the map. This is mere material for the memory, without any basis in interest. There is an indirect appeal to the pupil's industry and desire for topographical knowledge. It is, therefore, very difficult for children to read the text-books with interest. The books are essentially aids to revision. They imply that the teacher has gone through the matter before the pupil reads the lesson. This is, however, dangerous; for it prevents children from learning how to read a book; *and yet it ought to be one of the tasks of the school to teach them to read in a profitable manner*. Now and again, when a class has complained of a book being uninteresting, I have advised them to read it just as if it were a book of entertainment; and this has helped. If continuous reading takes the place of typical lesson-reading the matter is lifted up to a higher sphere and becomes fascinating. But this expedient is undeniably difficult to employ with the existing text-books of geography, however good they otherwise may be. They are most emphatically written in the lapidary style.

Another defect, found both in books and in teachers, is *that geography-teaching does not address itself to the children's imagination and volition*. Or, if it does, it is only in a very small degree. It seems to me, however, that in this respect geography can be made an extremely fruitful subject; and in my treatment of each country I seek to utilize it, according to circumstances, either as a bright example of enterprise and energy or as a dreadful warning, while I further bring into prominence those features which are likely to rouse the children's imagination to vigorous activity. In this last connection it is an excellent thing to deal with the area of a country and the number and density of its population by means of *copious* comparisons with Denmark or Europe as a standard. If, for example, one merely states the area and population of Russia, it goes through the children's heads without leaving a trace. But if a large number of comparisons are made, it dawns on the pupils how vast Russia is and how thinly peopled, how many persons it would contain if the density of population were the European average. The class then passes on with interest to the conditions necessary for Russia's attainment of the general European density of population. A good reason has now been provided for being interested in the significance of the seas, the character of the coastline, and the other natural features of the country. When all this has been gone through, the question arises of itself how it can be that Russia, in spite of its great natural advantages, is so thinly peopled; and there we are, discussing with interest and understanding such matters as political government, degree of enlightenment, level of civilization, and an interesting conversation may follow on the industries and the possibilities of future development. The idea: Russia gradually forms in the

children's minds. The facts do not lie a dead weight in their memories. They work with them. To use a bold expression, *they are statesmen in little, weighing the significance of Russia's present position among the nations and her probable prospects for the future.* So also with other countries. But influenced by the prominence given in scientific geography to the relations of cause and effect, to interaction and interdependence, the teaching of the schools has gone too far by making situation and natural features the *first* matters on which information is given. *It has been forgotten that what primarily interests children is man, and that in school interest in the facts of nature must, for this reason, be based on interest in human life.*

Let me, therefore, illustrate my procedure by another example. Let the subject be the East Indian islands. I do not begin by setting the pupils to name the islands or describe their configuration, etc. I assume they know such things from their home-work. I ask who owns the islands; and when that point has been dealt with I ask if the islands have any special importance for Holland. With this we have become interested in the area. But now I ask, for example, whether Greenland, which is approximately as many times larger than Denmark as the Dutch possessions are larger than Holland, is of equal value; a *motive* is thus supplied for interest in the situation and natural features of the islands. We study the wall-map with eager thoroughness and find lowlands, mountains, rivers, etc., that have no mention at all in the book, but are now interesting. Of course, the names of all these things are not learnt. From the situation and the configuration of the surface the pupils, aided by their knowledge of equatorial climate in general, can now form a number of conclusions on the climate of the islands and understand the chief features of the

vegetation, the leading industries, the hygienic conditions, and so forth.

If it be now asked how this oral instruction acts on the children, I think I can truthfully say that, as a rule, they are greatly interested by it. In the class conversations it is seldom that anyone is inattentive; and when the pupils say in letters how they like geography, it appears that this subject is a favourite. Still more instructive is the fact that the children account for their interest by remarks which prove that what sustains their interest *is the food provided for the imagination.* A pupil wrote: "Geography is interesting because when we have geography it is as if we were in the country the lesson is about," and another: "because I so much like coming out into the world and looking about me."

The pupils' interest and activity of imagination show themselves also indirectly in the many questions which they ask. Many of these bear witness to considerable mental agility and power of imagination. In a second class of the Intermediate School the following were among the questions put: "What does the earth look like from the other planets in space?"—"Is space empty?"—"Why can't the other suns (the fixed stars) give light when our sun is absent?"—"Why do not all countries have their Stone Age at the same time?"—"How is it that Uppernivik is not the coldest town in the world; in Siberia there are towns further south that are colder?"

Whether the indirect appeal made to the enterprise and energy of the pupils will have the result of their becoming more efficient than they would otherwise, is a question which can hardly be answered with certainty. One can only conjecture. But I am inclined to believe that by this method there is evoked a more powerful

will to advance than could be aroused by direct admonitions and edifying discourse. There can hardly be any doubt that the development of Denmark since the 'seventies and examples from foreign countries *may* have a stimulating effect on the pupils' volition.

The decisive test as to whether a course of instruction has been really satisfactory is partly the value of its effects in later years, partly the retention of interest in the subject, so far as further knowledge in that department is of service to life. But the customary teaching of geography, which mainly aims at imparting a mass of facts, most certainly has rather the effect of deterring the pupils from extending their geographical knowledge after they have left school.

CHAPTER IX

THE VALUE OF THE NATURAL SCIENCES IN EDUCATION

It is on the methods that the value of the individual subjects depends in the very highest degree; I assume, therefore, in what follows, that the methods employed are those which I have described.

In addition, we have in this inquiry to take into account the value both to the child and to the adult. The famous maxim: we learn not for school but for life must not obscure our perception *that we learn best for life by having our immediate child-needs satisfied*. But in this last regard it is particularly the natural sciences that possess great value, when the methods are rightly adapted to them. Nature of itself works powerfully on children, long before they go to school. Next to the home, it is the great "kindergarten" in which they gain their most numerous and their earliest experiences, from which they derive the first material for their impulse to work. Even children in the large towns obtain experience principally from impressions made by the material world; and children in small towns and country districts open their eyes in the midst of nature. They have natural objects, animate and inanimate, within their doors and close outside their doors. In respect of the mental world the infant experiences practically nothing but its parents' care and

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love, in addition to which it may pick up a few easy speech-sounds. But from the material world, " nature," it collects impressions every day. It perceives the light ; it tastes its way to a considerable sum of knowledge about the properties of things ; it grabs at and feels all that comes within its reach ; it has all its sense-organs in full use. *The infant is a little naturalist, that goes straight to the sources of knowledge about nature.* At the same time its education is, as a rule, formally correct in the main. The educator meets the child's needs, hands it the desired objects, and withdraws only those that are undoubtedly dangerous. As a result of this complaisance, the child, it is fair to say, develops phenomenally during the first year of its life.

The child which experiences for itself the properties of natural objects not only satisfies its immediate needs and accumulates a mass of knowledge about the physical facts of existence, about plants and animals, etc. ; it also receives impressions of beauty, after it has advanced somewhat in age. A little child certainly has no means of expressing appreciation of beauty—unless it indulges in spurious emotional outbursts, as adults so often do. But it receives impressions analogous to those which in the adult create æsthetic well-being. It merely has an æsthetic which is different from that of the adult. *But, so far as I have been able to observe, its æsthetic sense is the main motive for its interest in flowers and many animal forms.* My first impression in support of this view is the memory of my own and my brother's early-roused interest in flowers. The spring flora in a wood near our home, the hosts of flowering plants in the roadside ditches, and the many flowers in the garden attracted us by the impressions of beauty which they produced ; and the diminution of interest which I felt at school was

America.
2 maps combined. I M.

due, so far as I can judge, to the fact that in school nothing was done to meet the æsthetic need, while exclusive stress was laid on the plants' place in the system and on the details which were important in that connection. The system killed interest. It was as if a plant existed for no other purpose than to be placed in a "family."

By observing small children out in the open, I have been confirmed in the belief that it is æsthetic influences which form the motive for their busying themselves with plants. Colours, scents, forms, and so on, affect the child pleasurably and induce it to pluck flowers—very often such as the adult despises for more or less obvious reasons, e.g., the dandelion and the daisy. In the case of animals the æsthetic impression is also in part the source of interest; at any rate, small children are particularly attracted by highly-coloured or otherwise "beautiful" animals, such as butterflies, deer, etc. But, with regard to animals there are other motives besides the appeal of beauty, as I have particularly observed in the Zoological Garden. It is more especially the *young* of animals and the uncommonly *small* animals that fascinate children; but they are also attracted to the uncommonly *large* animals, and to great numbers of animals of the same kind. But that size has a weaker effect than the element of immaturity and youthfulness in an animal is shown by the case of Kaspar;* for it is quite indubitably a favourite in comparison with the otherwise popular Chang. In adults, too, one may notice the same preference for the youthful and the immature. I have observed, on the other hand, in connection with the terrarium, that unæsthetic perceptions cause lack of

* Kaspar, an elephant cub in the Zoological Garden; Chang, its father.

interest or even repugnance; the large ox-frogs, which at the outset rouse wonder by their uncommon size, are objects which most children refuse to describe, because "they are so disgusting."

Since the æsthetic in nature plays so large a part in children's relation to it, stress ought to be laid in education on this side of the natural sciences. In this way we shall meet an existing need which is of importance to life. But there are also other reasons. The fact is, the æsthetic side of education is grossly neglected. Schools are ugly. Schoolrooms are hideous. If they are sometimes decorated with "Art in the School," the decorations—from lack of understanding—are often so far away from children's æsthetic that they gain no profit from them. It is like giving them a jacket with such immoderately long sleeves that they are not big enough to fill them before they are ready to leave school. And yet the natural course would have been to use precisely the school as a means of awakening the sense of beauty. It may perhaps be objected that the homes of the children can only in a small minority of cases offer them impressions of beauty and that it would, therefore, be a mistake to arouse in them too lively a sense for the beautiful. But is not this an extremely unreasonable argument? It is equally not very often that the homes can give the children knowledge and whet their understanding; and yet the school lays the greatest stress on working in that direction. The churches are in many ways æsthetically educative; but it would be preposterous if in church architecture and the other arts we were to bow to the lack of æsthetic in the homes. Is not this very lack, finally, itself a consequence of the neglect to educate the æsthetic sense? Beauty is not the same as extravagance or splendour. The school, therefore, may very

well be made beautiful without being lavishly decorated, and in such a way that its means of achieving beauty may to a certain point be capable of transference to the homes. Just as the attention paid at school to bathing and cleanliness rouses the sense of cleanliness in general and promotes care for the person and the home in this respect, so school æsthetic would change the homes and elevate them on the æsthetic side.

But in æsthetic education the natural sciences can do more than lend a helping hand; they may even supply the foundation; for as in children there are æsthetic motives for interest in plants and animals, all that is necessary is that instead of directly or indirectly quenching this interest we should encourage it in an intelligent manner, just as we intelligently encourage children's early efforts to think. This can be done, for example, by the teacher expressing his own æsthetic perceptions, but in such a way as to avoid asking for a mere echo.

The development of the children's natural æsthetic can also be aided by drawing their attention directly to the fact that natural history treats not only of the life and structure of plants and animals but also of the impressions they make on us, and, therefore, that the children are free to say in their essays and oral deliverances what they find pretty and what they find ugly.

Besides this we can use plants in the class-rooms both for decoration and as material for instruction in botany. In this way their æsthetic value is emphasized. At the Intermediate School, I had during the first winter, crocus, snowdrop, tulip, daffodil, narcissus, hyacinth, and other plants in pots, and once when in the course of a lesson I was going to take a flower from a fresh hyacinth, I was earnestly requested to use instead a half-withered one

from another plant. In a similar way the æsthetic sense has often been in conflict with botanical interest.

With regard to the æsthetic factor, detail as well as quantity of matter appears sometimes in an entirely new light. For the purposes of purely practical utility the ordinary member of society hardly needs any great amount of knowledge concerning the names and attributes of plants or animals, those, of course, excepted which have a bearing on his occupation. As material for general culture the knowledge of names serves for the most part no purpose higher than that of ostentation. Many men have achieved success and distinction in manifold directions in spite of being sadly ignorant, relatively speaking, of botany and zoology. But, for the purpose of drawing æsthetic profit from nature, detail and knowledge of names and other matter may quite well be important. Certainly a forest or other mass of vegetation may produce a strong æsthetic effect even on a person who does not know beech from oak or spruce from fir ; but an interest in names and detail increases the field of enjoyment. The effect of close and attentive observation may be that a single tree, or even a single bough on a tree, may produce the most powerful impression of beauty (Japanese art). Careful examination of quite small things may reveal sources of pleasure which the unbotanical person does not command. A blue anemone is no doubt beautiful for the person who can only call it " a little blue flower." But its true beauty is only revealed to one who by attentive observation comes to see the colours of the stamens, particularly of the anthers, in their relation to the colour of the flower. The case is similar with most other plants and animals ; and the field for impressions of beauty is still further extended if one observes with the help of a magnifying-glass, an occupation from which children derive an extraordinary amount of pleasure.

Natural history, and also other natural sciences, such as astronomy and mineralogy, may thus contribute to the development of the æsthetic sense ; and as the sources of impressions of beauty are scarce, and as art in the true sense comes very rarely within the range of children's observation, especially in the country, school ought to see to the utilization of nature in the service of æsthetic education.

Besides being a source of æsthetic pleasure, nature acts on our emotional life in another way, with effects which, in some cases at any rate, possess a much deeper significance. I refer to that " feeling for nature " which is certainly akin to the æsthetic emotions roused by nature, but which yet contains an element peculiar to itself. In its weaker, less pronounced forms, the feeling for nature is little else than an unreflective sense of well-being caused by the outdoor world, the sunshine, the fresh air of the forest ; and it is then wholly unconscious, a result of physical conditions. But it may also be fully conscious, and it is then due more particularly to the recognition that man is a link in the chain, a part of the great whole. In its highest and strongest forms the feeling for nature takes on the character of a religious emotion, and may supply the lack of emotions otherwise derived from contemplation of the supernatural.

Of course, we must not infer that this feeling for nature does not exist merely because it does not find expression. Man has no words for his finest experiences. Even the greatest poets find but imperfect means of communicating their intimate and profound feeling of oneness with nature. When the reader has himself experienced analogous feeling, he understands in how great a degree words express merely the surface-ripples. With the

ordinary man the feeling either fails altogether to find expression or else it clothes itself in such banal phrases that their motive is easily overlooked. But it is there ; and, in primitive form, the feeling for nature occurs even in the child. On one isolated occasion I have seen it strongly manifested by a boy of twelve. Though otherwise lacking in energy, especially as regards bodily exertion, he clambered up a high cliff, sat there for a long time, and gazed out on the sea. Nature had captured him.

It is obvious that this peculiar feeling of being at home with nature can arise and become intimate only when nature produces *direct* impressions. If, then, children's capacities for such feeling are to be educated, they must be sent out into the open. But it is further reasonable to suppose that the understanding of man's kinship with the rest of nature needs deepening before the feeling for nature can be aroused. *But, rightly treated in point of method and matter, the natural sciences can lead to the unfolding of children's inborn capacities for the feeling for nature.*

The right method applied to the right matter has also the extraordinarily important advantage of awaking joy, the immediate, heartfelt joy which comes when the claims of the inner being are met. One day when a boy of twelve was helping me in the botanical garden, he used an expression extremely typical for the feelings of children when their inner needs are satisfied. In rugged language, but with warmth of feeling in his tones, he called up to me : " I do so like being down here rooting in the earth like this." The outburst reveals many things, including the fact that satisfaction was given to the boy's craving for action and his interest in flowers, and that at the same time deep-lying instincts had come into play : in

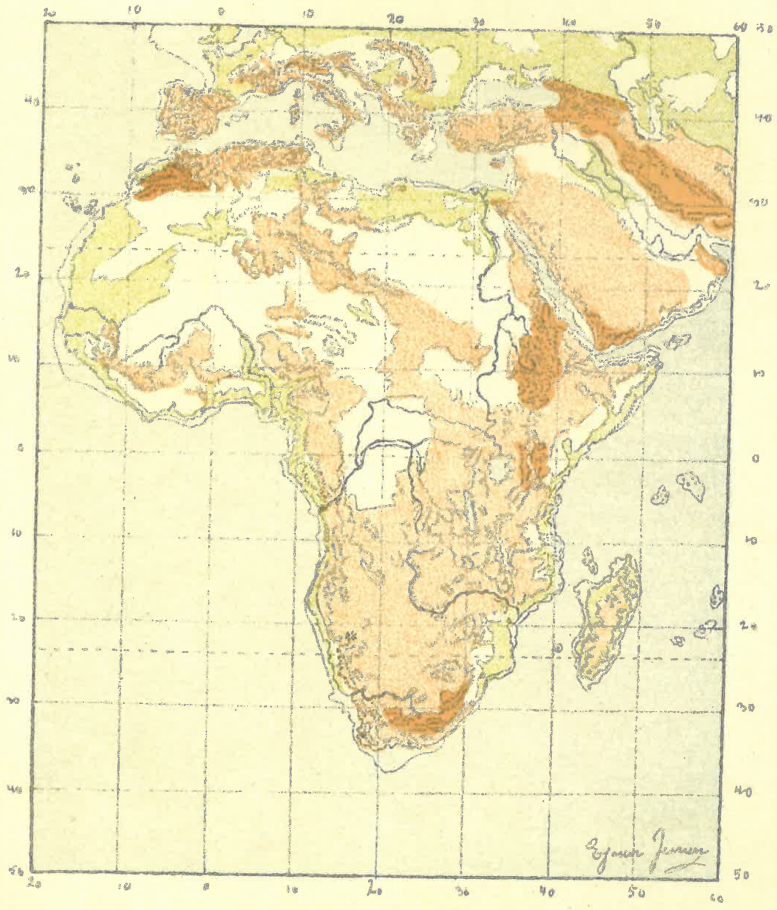
any case, joy in work shines out of his words. An intelligently arranged combination of botany and gardenwork is, therefore, highly valuable for children's development, *and there ought to be a school garden attached to every school.* It would serve the children as an arena for the twofold purpose of observation and work. Such a garden would be especially valuable if in laying it out due regard were paid to biological conditions, if, for example, plants which love the light and plants which tolerate shade were planted in such a way as to allow the superiority of the latter in the struggle for light to be readily observed. If there is a park or a forest in the neighbourhood of the school, or if such should be laid out, judicious planting without extra expenditure would allow the provision of an excellent field for plant-biological study, without the slightest injury to the æsthetic value of the park or forest.

But compliance with children's active impulses and interests is of the highest importance not merely for the emotional side of their nature. Such compliance has in education an all-embracing significance ; for it also supplies the best foundation for the development of intelligence, imagination, will, character and personality. The child has all the powers of the adult in rudiment, of course in different combinations with regard to degree. But as all the powers are there in germ, it is clear that if the children are allowed or encouraged to work in accordance with their inclinations, the all-round character of the work which will then be performed offers the best conditions for the germs arriving at unfoldment. The decisive manner in which each particular situation presents its demands to this or that capacity recalls the use of a pole in the moorlands to make springs gush forth. Of course, this compliance must be limited by the main

purpose of education: the best possible adaptation to life. It is not every impulse to activity and not every interest that is to be met and assisted to grow.

Among the rudimentary powers which the right methods aid to grow that of sense-perception is of great importance. Even in its primitive form, as unconscious or half-conscious activity, sense-perception has a decisive bearing on our welfare; but it is particularly the higher and highest forms of conscious perception accompanied by keen discrimination that weigh most in the scale. It is they principally that give us whatever stock we possess of clear and true ideas, of ideas, that is to say, which harmonise with reality; and however fortunate we may be as the possessors of foggy or even false ideas, there is always a risk in keeping them and never any danger in changing them for true ideas. *Next to the great value of the natural sciences as meeting the immediate needs of children, their highest utility is that of developing the powers of sense-perception and so increasing the probability that each individual, according to his peculiar endowment, will become more competent than he otherwise would have been to replace false ideas by true ones.*

To this exchange of false for true ideas, the natural sciences contribute not merely by developing the perceptive powers but also through the fact that they are fenced in with fixed prejudices to a far less extent than the mental sciences. In matters relating to these sciences there may be never so firm a belief, say in the flat earth or the motionless earth; it is only a question of time how soon this belief will be openly rejected—or tacitly laid on the shelf, the old being reconciled with the new by the expedient of reading the old account of the matter "figuratively." In this manner figurative language permeates the whole realm of natural science so that there



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is hardly a department of it in which the older notions have not now to be taken figuratively. This circumstance expresses the truth that in the domain of natural science experience is so hard-handed that in actual fact it always demolishes the walls of prejudice, even if it is recognized as a matter of form that an ancient fortress is still there. Besides, the phenomena of nature are far more transparent and simple than those of mental life. For this reason again, false ideas can be most easily replaced by true ones in all that concerns nature.

Even for sense-perception thought is needed, especially when the perception is to be nicely discriminative; but still greater demands are made on the power of thought when the latest experiences are to be worked up with earlier ones, in order, e.g., that they may be understood in relation to their causes and effects; and probably no one will dispute the extreme value of the development of the power of thought taken generally. But there are particular forms of thought, doubt, and criticism with regard to which some may be inclined to hesitate. Of course, such hesitation, so far as it exists, is due to want of reflection; for if we are to recognize the importance of developing the power of thought and lay stress on it in educational practice, it is inevitable that both in principle and in practice we shall also recognize doubt and criticism —or else retract our recognition of the capacity for thought. From the examples which I have given of children's manifestations of reflection, doubt, and criticism, it will be immediately seen that there is only a difference of degree between these various forms of thought. Very often it is difficult or even impossible to decide whether a question or a remark discloses doubt or criticism, or whether it is merely evidence of a general desire for knowledge and of thoughtfulness.

ESCUELA TECNICA SUPERIOR DE INGENIEROS AGRONOMOS BIBLIOTECA

But, in addition, doubt and criticism are in themselves of the very greatest value. The growth of knowledge during the last centuries is principally due to doubt and criticism; and these factors have operated not only outwards against the assertions of others but inwards against the individual's own perceptions and mental activity in general. Doubt and criticism have not merely given increased keenness of vision for the sources of one's own and other person's mistakes, but have also tuned up the demand for agreement with reality. These forms of thought are therefore highly serviceable to life, so that it well accords with the purpose of education to develop the pupil's tendencies towards doubt and criticism, where they exist.

One of the reasons why the demand for the recognition of doubt nevertheless meets with so much resistance is a misunderstanding of the nature of doubt. To begin to doubt is construed as equivalent to remaining in doubt. The celebrated aphorism: "We ought to doubt everything," is taken as an injunction to be *always* in doubt about *everything*, whereas it really means only that there ought to have been doubt before there was final or even provisional belief. To begin with, each element in the content of consciousness is on its first emergence possibly taken as true; but this is by no means certain, as many such emerging elements present themselves at the very outset in the interrogative form: "Is not so and so the case?" With many persons, at any rate, doubt makes a very prompt appearance. One begins by doubting the truth of the first idea, so that at its first appearance doubt has a predominant character of denial; but the end may quite possibly be that the earlier idea is approved and the later one rejected. Denial, which is doubt's attacking note, may very well lead to a cadenza of affirmation.

Indeed, *doubting will only mean seeing more than one possibility instead of being certain that there is only one.* Once having seen this, the doubter enters on a critical examination as to what possibilities there are altogether, and which of these is or are reality. If this can be decided there is no more doubt. But if it is impossible—temporarily or altogether—to make this decision, he remains in doubt—and ought to remain in doubt. The person who sometimes doubts has thus a better chance of knowing the truth than the person who is always in a state of certainty. Doubt is the road to true belief.

It would, of course, be regrettable if the domain of the doubtful were increased by doubt being recognized and acted upon. But according to experience that is not the effect of doubt. *The time which has passed since mankind with full consciousness approved the principle of doubt is precisely the period during which a vast harvest of objectively valid experience has been reaped in fields once the realm of the doubtful; and in the individual man steadfastness, firm-footedness increases in strength when he begins to doubt and examine.* Psychologically, doubt is often merely a safety-valve for belief. The man who acknowledges doubt as a principle and carries it out in practice often has, in respect of what he deems worthy of belief, a far firmer faith than that of the "believer"; and if only the safety-valve is in order no harm will result if it should some day prove that something untenable has been believed. For those who make a principle of belief the case is otherwise; when one cause or other does arouse doubt in them they must either deny their principle or feel themselves inwardly in conflict with it.

Faith and belief are not excluded by doubt; for faith is nothing else than the holding fast to an idea which is taken as valid. Therefore all "believe." The difference

between the doubting and the believing types depends, therefore, on the antecedent conditions of belief. The one type believes on the strength of universally valid proofs, the other believes without such proofs, and, indeed, often in spite of the most decisive proofs. The " believers " respect first and foremost whatever they have come to believe in on casual grounds, common sense only in the second instance. The doubters, on the other hand, do not entirely respect even common sense, but require it to go arm in arm with wholesome doubt.

The frequently expressed fear that doubt may paralyse men's wills rests mainly on a misunderstanding of the nature of doubt.

Some fear harm from doubt because they think that doubt leads to despair.* Here language is playing them a trick. In spite of etymology it is by no means the case that those most prone to despair are the doubters. Those who believe strongly are much the readier victims of despair when their hopes are now and again mocked. Others are uneasy because they assume that doubt of necessity leads to the doubting-mania. They forget that there is also a mania of belief. In the discovered mind both doubt and belief may run to extravagant lengths. Others again, more moderately, but still partly in the same spirit, maintain that the doubter becomes unable to make up his mind, but wavers hither and thither in perpetual indecision. There is some truth in this, but it is greatly overstated. It is true that the desire to act and the vigour of action are weakened when doubt is present, but it must not be overlooked that they return when the doubt is overcome and replaced by

* In Danish *tvivle*=to doubt, *fortvivle*=to despair. Cf. German *zweifeln* and *verzweifeln*.—Tr.

belief. And that weakening of the active impulses which doubt causes is itself, as a rule, no misfortune. If the doubter had, instead, been a believer, firm of purpose and vigorous in action, and if he had, in consequence, committed himself to some unwarrantable act, a grain of indecision would have been more profitable. Doubt is, therefore, also valuable in respect of the direction and the vigour of our actions ; and it is by no means always that doubt restrains. If it is directed towards a negation it may even be a stimulus. If, for example, a man doubts the impossibility of steering an airship from an office-stool, he may possibly become the inventor of the apparatus necessary for that purpose.

In situations of great tension conscience will, as a rule, function as the supreme court whose ruling is final. But even in the interests of conscience exercise in doubt is of great value. Conscience is capable of development, and is modified, for example, by reasoning. Otherwise conscience would be the same now as in the earliest ages. Whenever a question has been thoroughly examined, conscience has become different ; and by close inquiry into the legitimacy of actions conscience acquires refinement. To give children the habit of doubting is thus to set them on a profitable path. Education does not begin in real earnest till the pupil himself takes a hand in it ; and this is particularly true of the more intimate personal concerns. The educator's true task is to induce the individual to set about his own rational self-education. But this implies, among other things, that doubt is awake and active. The main trouble is not that we have erroneous opinions as to what is true or false in the ethical domain, any more than in other fields. The prime requisite is that all should be able to abandon their erroneous opinions when the error of them has been

demonstrated by valid proof. But this flexibility of mind can be attained if the individual has been trained to doubt.

It is a mistake to think that doubt brings with it a predominant state of unpleasant emotion. True, the dividedness of mind that prevails so long as doubt exists on some item in the mental content has an immediately depressing effect, while the assured sense of being in the right produces, as a rule, immediate pleasure; but this is not universally the case. Doubt may also bring joy. That experience which comes to us so monstrously often, of finding something, regarded as certain, turn out to be based on an illusion, may result in the emergence of doubt being hailed with joy, because a hope is aroused that once more an illusion is about to be unmasked, that some new truth is on the point of being accepted. Since, also, doubt is a necessary condition for so much and so valuable thought, it would be a paradox if it were inevitably bound up with painful emotion. A glance into history may reassure the distressed doubter; for it shows that where assent is trustfully given, as in ancient Egypt, beliefs persist for immeasurable ages, while they are subject to perpetual change where doubt prevails, as in ancient Greece and the modern civilized states.

Again, it is hardly true that all doubt weakens. Doubt may weaken; but it may also impart strength. It may, on the other hand, be rightly affirmed that doubt demands effort; but it does not follow that it weakens. Athletic sports exact effort, and are yet strengthening. The doubter who masters his doubt gains also in strength.

By reason of its bearing on our search for truth, doubt is further of great importance for discoveries and inventions. No doubt many discoveries and many

inventions are made casually. But most often doubt is the impelling force, or at least a co-operating factor; and when it is suppressed by any cause inventiveness is checked. A celebrated example is Newton's assertion that it was impossible to make achromatic lenses; for the extraordinary weight of his authority prevented anyone making the attempt. It was not till someone doubted the truth of Newton's assertion that the problem was solved. If individuals had not doubted the impossibility of constructing dirigible balloons and flying-machines, the inventors would not have gone far in the practical solution of these problems. Had no one doubted the excellence of current educational methods, there would have been no one to suggest innovations in this field. As a rule doubt, or conscious criticism, of to-day's best attainable, is present in the person who finds a new path through the desert.

By thus increasing the probability of new acquisitions, through discovery and invention, doubt becomes important for the growth of initiative in range and power. When there is a certain looseness of conviction regarding the agreement of current ideas with reality, when the note of certainty is somewhat vaguely accented, then there will the sooner appear one whose desire to make a new start will take the form of discoveries or inventions and their application to wider use. Where there are fixed forms of belief, initiative travels on paths already made; and there are not many paths because the fixed forms limit the number of the fields of activity.

In the existence of doubt there is finally a factor of the highest importance for the holders of authority in a society. Where there reigns fixed belief, which automatically takes the form of authoritarian belief, an individual may acquire immense power by virtue merely

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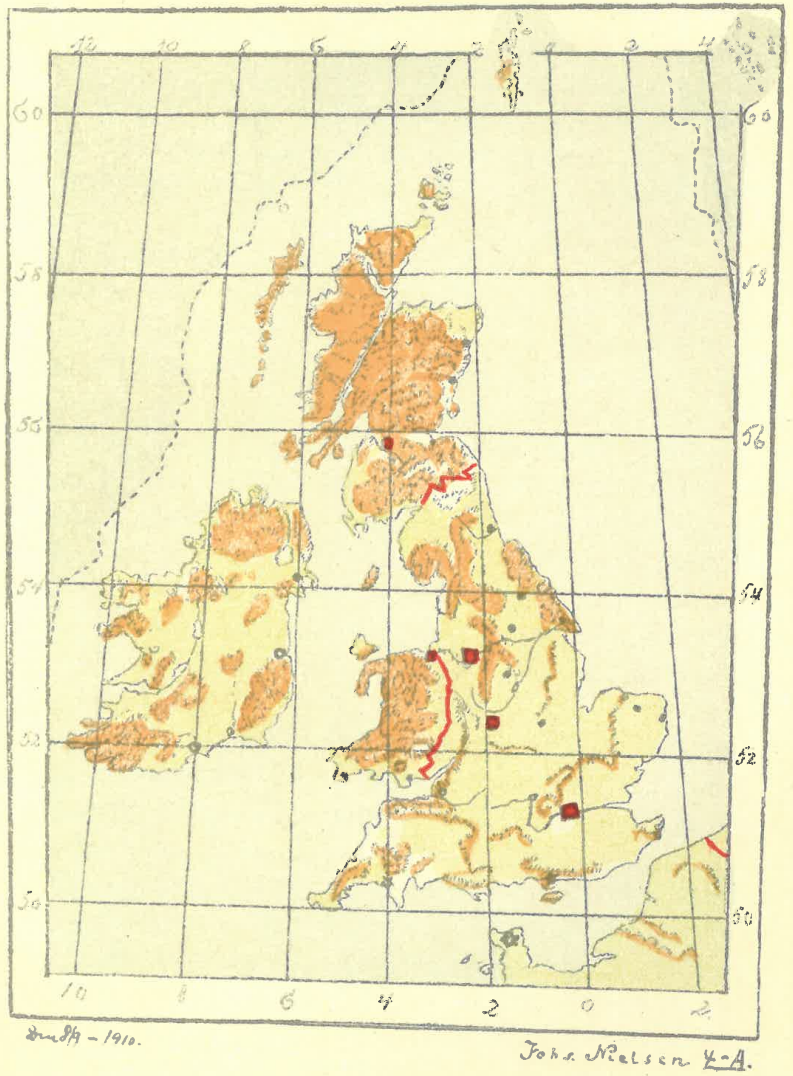
of his position (princes, popes) or by personal forcefulness. Doubt is, on the contrary, dispersive of power. It compels the possessors of power to justify their use of it, and so weakens them for the immediate exercise of authority. It collects doubters and conscious critics into an opposition. Therefore the acknowledgment or rejection of doubt as a principle depends on the distribution of power in a society. In authoritarian societies doubt is instinctively or deliberately combated (the Catholic Church). In societies with highly-developed popular government the principle of doubt is, on the other hand, most easily approved.

But the high value of doubt and criticism for the adult is no proof that they ought to be introduced into the education of children. A special proof is needed for the assertion that children should learn to doubt and become accustomed to criticize; and such proof must in part rest on the existence in children of aptitudes for these activities, and in part on the desirability of yielding to the manifestations of such aptitudes. Possibly they would best lie fallow during the years of childhood.

In regard to the first question, I have collected many casual observations relating to small children,* which show that doubt occurs very early; and as doubt but rarely finds expression with the adult, and by analogy from what can be inferred as to the adult, we may rightly conclude that with children the state of doubt occurs with a frequency which is high relatively to the number of observable cases. Parents, who have the most intimate association with children, are in the best situation to observe and collect material bearing on the expression of doubt.

Concerning a girl of four to five who had told a lie,

* See Vilhelm Rasmussen: "Child Psychology," I-III.



Great Britain and Ireland.
Self-imposed home-work. IV M.

I heard the following from an entirely reliable source. Her mother said to her: "If you tell lies in that way, you'll get a black cross on your hand." The little one became somewhat thoughtful, and at night she looked at her hand, but found no cross. When she woke early in the morning she observed her hand again, and as she still found no cross, she said to her mother: "Mother, there isn't any cross." When the mother merely answered: "That's all right then," the little one said: "Was that true about the cross, Mother?"

A similar story was told me about a little girl of three by her mother, though here there is a more definite expression of doubt. This little girl had also not kept to the truth, and in order to get her to confess her nurse had said to her: "You'll get a black mark on your forehead if you don't tell the truth." But the little girl answered quickly: "No, I shan't." "Yes, you will," was the answer; but the child said: "Mother, may I borrow the looking-glass;" and when she had verified that there was no mark, she turned in triumph to the nursemaid and exclaimed: "There, now, you were making a fool of me."

Parents and other educators give children far too frequent opportunity for doubt, not merely as to the realities before them, but also as to the truthfulness of those who give them information. During a journey I heard a mother say to her little girl: "You mustn't look out of the window or you'll fall out of the train." The little one put on a very puzzled look. In a tramcar a mother said to her little boy who wanted to sit on the seat and not on her lap: "You mustn't do so before the man" (the conductor).

The older children are, as is natural, far more apt to doubt than the little ones—judging by the frequency

with which they express doubt; and this doubt is directed towards a number of conventional views and customary assertions, as a few examples will illustrate.

A boy of ten said to his mother: "The stork can't bring little children, because little brother came in the winter and there weren't any storks then," and later: "And mother didn't need to go to bed either if the stork came with little brother."

Another ten-year-old asked in various Bible lessons: (1) "Why doesn't it say that one thing more bowed down before Joseph; because he had one father, *two* mothers, and eleven brothers?" (2) "How were the negroes and Indians created?" (3) "Did Jesus love the scribes and pharisees as himself?" (4) "Christ prayed to himself in Gethsemane, because he was God."

Doubt stands out very comically in the following question, put by a girl of eleven on hearing about the Jewish Temple: "Yes, but Miss, did no one ever clean up the Holy of Holies?"

When the pupil's doubt is met and recognized, it manifests itself, as I have already shown (p. 157), with great strength, both as outwardly directed doubt (and criticism) and as inwardly directed doubt touching the trustworthiness of the observing faculty, the sufficient range of the observations, the correctness of the expression in language, etc.; and with increasing maturity, doubt and criticism grow. It is therefore an established fact that in children, especially the older ones, there is a disposition to doubt and criticize. Shall we then, in spite of this fact, and in spite of the value of doubt and criticism when expressed by adults, repress them or root them out when they appear in children? On no account! To root out doubt and criticism is quite impossible, and it is extremely difficult to prevent overt expressions of doubt

and criticism so far as one lays stress on training to independent thought. If they are forced inwards in the child the result may easily be ill-will towards the educator, or, at any rate, suspicion and distrust in his capacities, particularly his knowledge. But if doubt and criticism are allowed free scope, the educator's honesty is raised above every doubt, and the pupil has occasion to appreciate his relatively large stock of knowledge and to understand that it is impossible to be fully informed about everything or to be ready with a reason in every possible case. The fear that permission to doubt and criticize will destroy the good relations between pupil and teacher is, therefore, wholly unfounded. On the contrary, the case is rather that good relations cannot begin in earnest till such toleration makes them possible. The pupil experiences a sense of emancipation in regard to the teacher which arouses sympathy for him.

We must not, of course, impose doubt and criticism upon children, but merely extend a kindly tolerance to their manifestations of doubt and criticism. These manifestations are a form of exercise which, like every other exercise, is based on the children's giving proof of a desire to exercise themselves. We therefore *follow* the natural development of children by allowing them facilities for doubt and criticism, which in themselves are activities of service to life. But to recognize doubt as a principle and then deny it in practice is hardly worth much. The child must understand that it is an independent thinking and judging entity; therefore it must also be allowed the possibility of expressing doubt and criticism. All educators, moreover, are agreed that the character and personality of the pupil ought to be brought to unfoldment; but how is that possible without concessions to those who have an inclination to doubt and

criticism? Of course the educator must not be perpetually saying to the pupils: "You must doubt." But they should be told once for all that they may freely express doubt and criticism, and when they then let it be seen that they do doubt and criticize, they should be encouraged, because they have been thorough and sharp-sighted. The expressions of doubt and criticism will then be as natural and as much a matter of course as, for example, children's accounts of their own observations and experiences. Besides, the teacher, while retaining the full interest of his class, may point out the utility of doubt when some pupil has shown conspicuous want of caution. Once during a physics lesson, a boy who had been sent to the stove with a declination-needle went wrong about its poles. I then asked him to test the magnetism of the door; he set about it cheerfully and found how the door deflected the needle. I took occasion to explain the danger of too ready belief.

The natural sciences, so far as I am right in the foregoing considerations, *possess a very high value in that they meet and exercise children's aptitudes for doubt and criticism as well as other forms of thought. But since the natural sciences thus foster both the perceptive faculties of the pupils and their capacity for thought in the narrower sense, they are a valuable means for training the pupils for rational inquiry in all generality*. Of course the rational is relative and limited by the pupil's stage of development as well as by his endowment; but among adult inquirers, too, rationality is relative.

Here I may allow myself a few words on the desirability of the spirit of inquiry and the capacity for inquiry becoming more and more widely disseminated. Practical life teaches everyone every day that that work on which his livelihood depends becomes more profitable if he is

a conscious and independent investigator of rational modes of working. Not only has applied science penetrated into numerous practical callings, but the scientific spirit of inquiry has diffused itself among all classes of workers. The welfare both of the individual and of society would, therefore, gain largely if education set itself consciously and rationally to accustom children to being investigators, so that every adult may be an investigator in his own particular field, possibly an innovator capable of taking a long step forward. The training of child-investigators is, moreover, in closer agreement with child-nature than the forms of education generally recognized or at least put in practice. Education by lesson-learning is immeasurably distant from the child's own desires. Children have no spontaneous inclination to this piecemeal appropriation of second-hand knowledge. Neither is Grundtvig's education by discourse in so close agreement with the nature and the desires of children as many suppose. Speech before sight is unpsychological. It is true enough that children willingly listen to a teacher telling them something and learn from him; but it is truer that what they most wish is to work, observe, experience, investigate for themselves. Even the infant investigates its surroundings independently long before it has any pleasure in listening; and if a group of small children has the choice between a gravel-heap to root in, a pool of water and a few chips to sail in it, or a tale, they will hardly prefer the last, even if it deals with goblins and witches. The impulse to activity is fundamental, and in satisfying it the child, as a primitive investigator, learns from its own experience the qualities of its immediate surroundings. To make this childish investigation more rational, without putting pressure on the child, and in such a way that it

may immediately notice the advantage it gains, is the main problem for the education of intelligence. *The pupil is to be taught the rational use of instruments, both material and mental.*

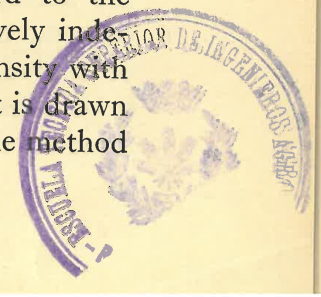
One of the reasons why children would rather hear someone telling them something than learn lessons is that the narrative method sets their imagination to work in a far higher degree than " the dry lessons " ; and hence it has been wrongly deduced that the narrative method gives the best education for the imagination. If this were the case it would undeniably be a great argument for the narrative method, for the pictures of imagination are children's daily bread, and in school the imagination ought to be fed, developed, and made valuable. But this is best done by following the child's fundamental impulse, the impulse to activity, and by ministering to its spontaneous interests. Speech before sight should be replaced by the more psychological slogan : Sight before speech.

Many, perhaps, will regard it as entirely unreasonable to suppose that the direct perception of natural phenomena is a good education precisely for the imagination. But they misunderstand the nature of imagination, confusing it with the fanciful dwelling on unrealities, goblins, witches, and the like. Imagination is merely a particular form of mental presentation, as necessary for the study of nature as for that of the human mind. It is in part an expansion of presentations, as when Newton extended the notion of the causes of falling on the earth's surface so as possibly to apply to the moon's course round the earth. In the natural sciences there is ample scope for rational imaginative constructions of this kind. Inventions, discoveries, are in large part transferences, new combinations, extensions of familiar ideas. All investi-

gation requires the play of imagination. *The growth of imagination in a sound direction is, therefore, a requisite of the first importance ; and in regard to the development of imagination, the direct perception of nature by the senses is of high value in the education of children.*

That natural phenomena cannot give rise to the imaginative constructions which can be evoked by fiction, and which are necessary for the production of fiction, is another matter ; but then there is no one who desires children to be educated by being kept exclusively occupied with nature. Of course, too, there is a difference between the freer play of fancy for which fiction and other arts give occasion, and the imaginative constructions which are tethered to nature. These latter are continually tested against unyielding reality, while the free fancy of fiction may gambol almost unchecked. But in compensation for the limits which contact with nature imposes on the imagination, its products have a more universal validity than the relatively free creations of fiction. If they are in agreement with reality they may in their turn become starting-points for new constructions, new knowledge. An example in illustration is the sequence : Hertz's theory of electric waves—wireless telegraphy—wireless telephony—radio.

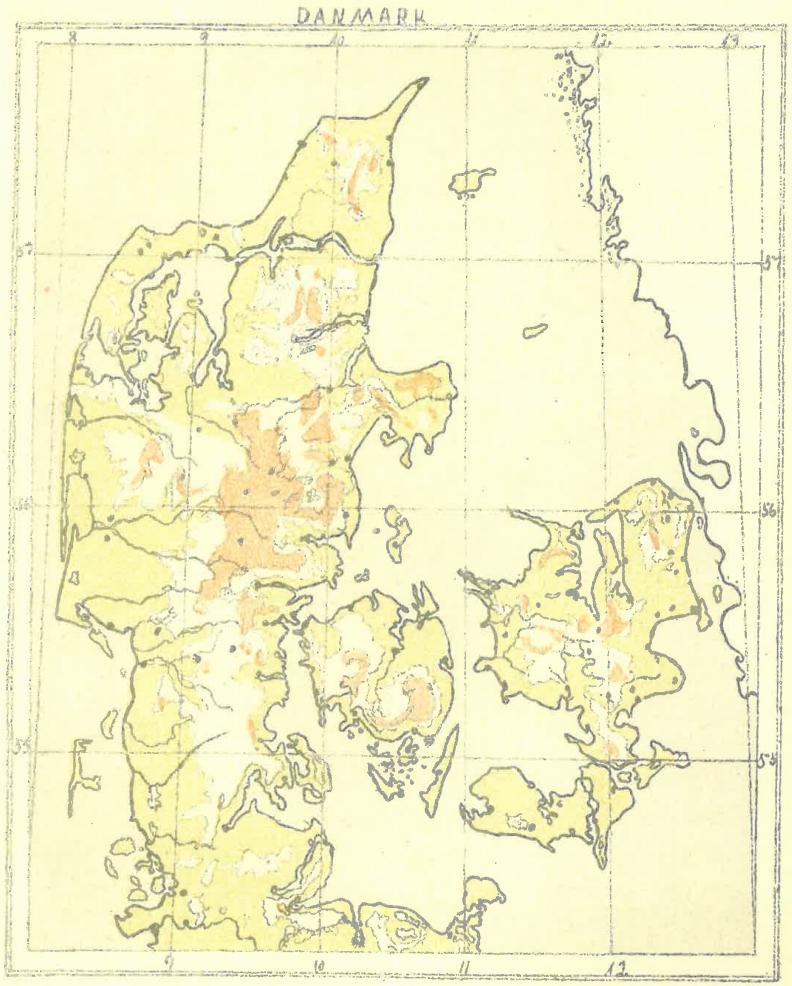
Since not only the faculties of observation and thought, but also imaginative power, are of great importance for scientific inquiry, we come finally to the result that the natural sciences, when the right methods are employed, have the inestimable advantage of promoting the development of the investigator type. Both in regard to the number of men who are set working on relatively independent investigation, and in regard to the intensity with which the individual actually investigates, profit is drawn from allowing the natural sciences, taught by the method



of direct investigation, to play a leading part in education. As far as intellectual education is concerned the ideal goal is that each member of society, so far as his endowment permits, shall become an independent investigator, at the least in his own special field.

An advantage, lastly, of the highest value is the great effect which the direct investigation of nature produces on the child's morality. As I have shown by quotations from essays, the child becomes frank, truthful and honest. This is in part due to the fact that the phenomena of nature, as I have already remarked, are—relatively—so indisputable, and in part it comes about because the effect of independent work is to make the child understand that the main thing is not to get good marks, or the like, but to apprehend rightly the phenomenon under consideration. For example, when a child writes: "I do not rightly know whether the ground-beetle has two or four feelers," this is evidence not only of honesty but of desire for accurate information. Otherwise the child would simply have said nothing about the number of feelers. But remarks analogous with this quotation are extraordinarily numerous in both the natural history and the physics essays; and the questions asked by the pupils while they are writing are indirect evidence pointing the same way. *Thus in its formative aspect the direct investigation of nature has the immense value of being an exercise in honesty.*

In addition to the special value which the natural sciences have on the *formal* side: for the development of the perceptive faculties, the imagination, the associative process, true thought, feeling, will, etc., they are also, of course, highly valuable because of the actual *knowledge* conveyed to the pupil; and once justice has been done to their formative function, it is self-evident that



Denmark and the northernmost part of Germany.
IV M.

the most important knowledge for this purpose is that which is most needed in the battle of life (the principle of utility). But the quantity of information which can be imparted to children is always extremely small relatively to the sum of information possessed by each branch of science. As a rule one must be content with a small selection of facts, applicable to the illustration of the laws which the pupil is to be educated to utilize in practice. We are going astray, therefore, if in any great degree we lay stress on introducing the pupil to the highly-developed technique of the applied sciences. In this field the smattering which practice has led the school to give is sufficient. To go further on this path is dangerous, partly because it would obstruct the modification of methods in the direction of giving predominance to independent investigation. The technique which the pupils *are* to learn ought, however, as already said, to precede the theory on which it is based. As example, take the steam-engine.

Knowledge of nature is again nearly always a necessary condition for the understanding of the ordinary school instruction, even in the mental subjects; and for this reason alone, natural science should receive relatively comprehensive treatment in the first school-years. But this is also necessary for other reasons; both the immediate satisfaction which the natural sciences give to the impulses of child-nature and their great value on the formative side count in favour of their having a greater place in the *first* years of instruction. This will naturally mean curtailing the time allotted to other subjects, but there is no need to exaggerate the loss. Not a few of the exercises in various kinds of skill which are now practised in the abstract, with no definite connections, solely in the interests of the child's future, might be made of

immediate value to the child by being associated with the direct investigation of nature.* Certainly practising conversation on natural phenomena might with advantage replace to some extent the ordinary tiresome exercises in reading, often about trivialities.

The natural sciences may finally gain a quite special importance if instead of presenting the matter in fragments we work it up into a comprehensive whole embracing the most general of the certainly known laws of nature. But this is not done, and still less is any conscious effort made to bring home to the pupils that the knowledge of laws is the chief means of predicting the future with certainty. *The art of prophecy has in our days fallen into the hands of exact science.*

When Christianity satisfied the needs of men in regard to an explanation of the whole of existence—in the classical period of Christianity—the individual acquired a conception of the whole which passed with him for exhaustive and unconditionally true. Scientific investigation has gradually revealed untenable elements in the Biblical position, but no conscious effort has been made to co-ordinate scientific knowledge in a readily comprehensible general theory of nature. The quantity of detailed experience has been so overwhelming and the emergence of new views so persistent that practically there has been no common foundation to build on. From the recognition that so many apparent certainties have proved unreliable the consequence has followed that no attempt has been made to collect what can be said with relative assurance on the fundamental attributes of material existence. But this lack of a co-ordinating survey is an essential factor in that loss of fixity in outlook

* For details see the author's "Samfunds-Skolen," translated into Russian.

and conduct which we so often witness; and from the point of view of national pedagogy there is every reason for striving to create such a relatively fixed point in each individual consciousness. More than relative it cannot be, for the maintenance of doubt sets a limit to fixity.

A general theory of natural science would not only create personal stability of this kind, but it would also in a high degree limit the field of superstition and strengthen the desire to find natural causes for phenomena. Its true importance, however, would be that by inducing the recognition of the universal sway of law, *it would indirectly increase confidence in man's power to make existence useful to him in the widest sense.*

Where there is conformity to law, and where this conformity is acknowledged, it is possible to predict with certainty. Under such and such conditions, something quite definite always happens. If one can bring about the requisite conditions, one can therefore also bring about the desired results. On this depend the applied sciences, e.g., Chemistry, Physics, etc. But in education we are as a rule satisfied with allowing the pupil to gather experience of the particular; whereas he ought, in conformity of course with his degree of maturity, to be led on to the knowledge of the chief laws of matter, and to learn the value of their utilization in practice and theory. In illustration I will merely mention plant-cultivation and stock-breeding, which, though it is still far from possible to obtain every desired result with certainty, are still shining examples of what man can achieve to his advantage by availing himself of nature's conformity to law.

The production of new types among plants and domestic animals is, however, merely a special form of